FEB 27 1926

RAILROAD ISSUE

Engineering News-Record

Devoted to Civil Engineering and Contracting
McGraw-Hill Publishing Co., Inc.

February 25, 1926

Chicago Terminal Electrification of the Illinois Central R. R.

Railway Construction, Recent and Prospective

Creosoting Plant of the Southern Pacific Ry. at Oakland

Elgin, Joliet & Eastern Ry. Builds Longest Ballasted-Deck Plate-Girder Bridge

Hauling Ties Forward, Southern Pacific New Line in Arizona

KREOLITE

Outlast the Factory

Save Overhead, Under Foot

THE race for business is on! Competition grows keener daily! Your factory cannot win in the contest for lower production costs if it is handicapped by a "poor track."

The floor is the *base of operations* for men, machines and material. It either facilitates production or retards it. Uneven, cold, clammy floors, dust, dampness, rust and disease pull down workmen and slow up work.

One man can handle a truck on the smooth surface of these impregnated blocks that requires the strength of *two* men on other floorings. Best of all, once laid Kreolite Blocks *permanently* end your floor problems.

Patented construction makes provision for expansion and allowance for shrinkage. Kreolite Filler penetrates through the grooves to the very base, binding the blocks into a compact, sanitary unit.

Hundreds of manufacturers in all lines of business—machine shops—foundries — warehouses — paper mills, etc., bear testimony to the wonderful results accomplished with Kreolite Floors.

REDWOOD

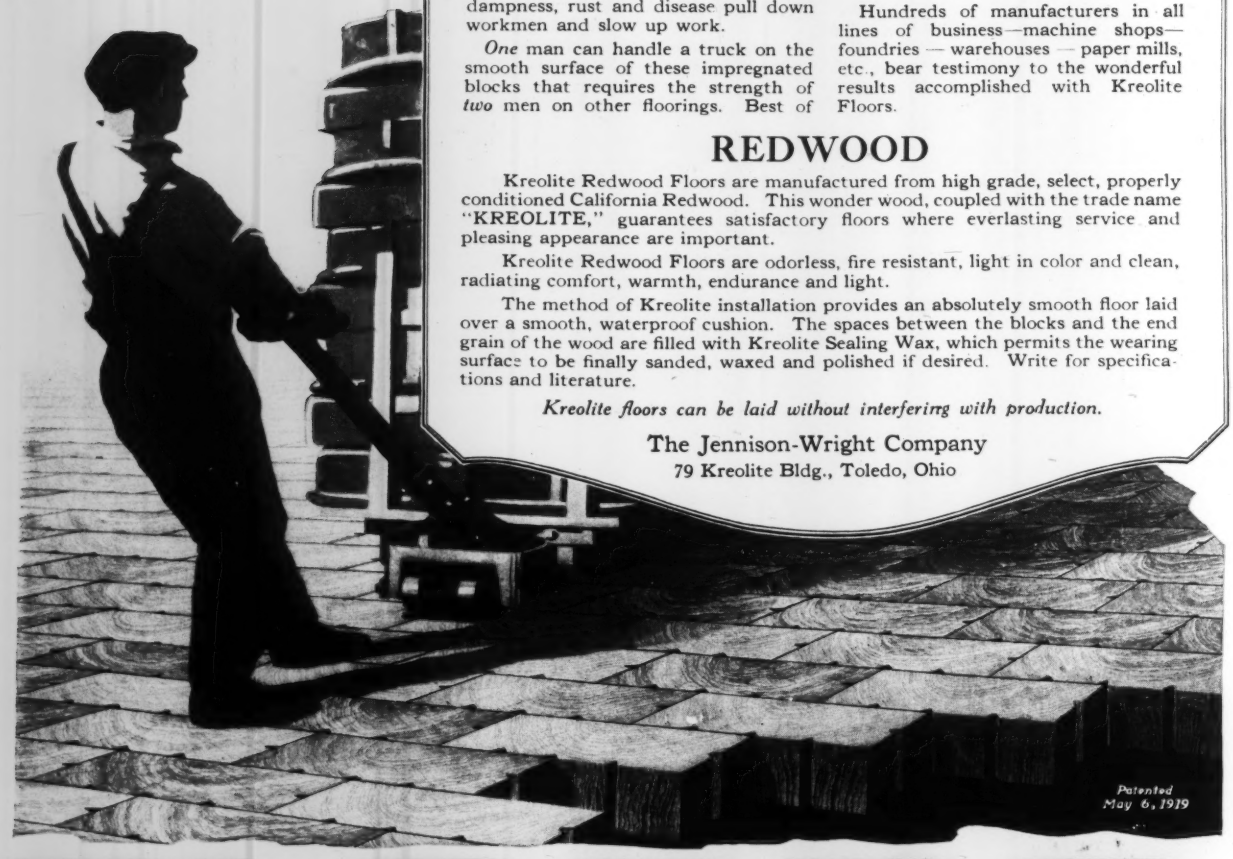
Kreolite Redwood Floors are manufactured from high grade, select, properly conditioned California Redwood. This wonder wood, coupled with the trade name "KREOLITE," guarantees satisfactory floors where everlasting service and pleasing appearance are important.

Kreolite Redwood Floors are odorless, fire resistant, light in color and clean, radiating comfort, warmth, endurance and light.

The method of Kreolite installation provides an absolutely smooth floor laid over a smooth, waterproof cushion. The spaces between the blocks and the end grain of the wood are filled with Kreolite Sealing Wax, which permits the wearing surface to be finally sanded, waxed and polished if desired. Write for specifications and literature.

Kreolite floors can be laid without interfering with production.

The Jennison-Wright Company
79 Kreolite Bldg., Toledo, Ohio



WOOD BLOCK FLOORS

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 96 NEW YORK, FEBRUARY 25, 1926 Number 8

Railway Expansion

SIGNS of steady, if slow, increase in the construction of new railway lines and extensions of existing lines come as a pleasant relief after a decade of inactivity in this line of engineering. A review of recent and prospective development, given on another page, shows a fairly widespread distribution, though centered mainly in Florida, as part of the present boom, and in Texas, where there are still large areas without railway communication. Only a few of these railways are of conspicuous length, 100 miles being about the maximum, but in the aggregate they appear to indicate the beginning of a period of railway extension. It is not to be asumed that the railways have been idle because they have not been building extensions. On the contrary, an enormous amount of work has been done and money spent during the past few years in improving the existing lines and providing facilities for the more efficient and economical handling of heavy traffic on the main routes. This work and expenditure will continue indefinitely. But it appears evident that the time has come for further expansion of the railway system, both by means of extensions into new districts and by linking up detached lines to form new routes, and partly, to be sure, by the substitution of bus lines for lightly loaded side roads.

A Bad Policy Disavowed

PENNSYLVANIA has at last unsnarled the Delaware River Bridge toll tangle by legislative action providing for toll collection until the cost of the structure is refunded. A bad situation is thereby relieved, for New Jersey and Pennsylvania had reached a hopeless impasse in consequence of the former's refusal to proceed with the final work on the bridge unless its bridge-construction bonds were protected by the collection of tolls to cover interest and retirement. There was no likelihood of New Jersey's receding from this stand, and a Supreme Court action brought by Pennsylvania to force completion of the bridge would probably have meant long delay even if it had succeeded, which from a non-legal viewpoint seems open to doubt. The solution now reached by Pennsylvania means that the bridge will be opened to traffic this summer and that tolls of quite moderate amount will repay the entire construction cost in a short period of years, leaving the bridge a free avenue of transit within possibly a dozen years from now. The principle of toll refunding receives powerful support by the adoption of this system, and incidentally the prospects for other crossings of the long unbridged reach of the Delaware from Trenton to the sea are improved. These are significant results. Nevertheless, interstate comity and good faith received a hard blow in the earlier history of the case, and some effects may remain a long time. Looking back at the facts, it is plain that the no-tolls proviso of Pennsylvania was a deliberate violation of the understanding with a sister state, whose financial obligation to collect refunding tolls was known to all. To realize that a great commonwealth may indulge in such moral somersaults is a serious shock to one's belief in the scrupulous integrity of states in carrying out interstate undertakings. Let no state hereafter enter an interstate obligation on any implied understanding or with details left to be adjusted later on, lest it find itself betrayed. Superlative caution must be the watchword. By its action of the past week Pennsylvania disavows a bad policy and in a sense makes apology for its action of a year ago; but the outcome would be more pleasant to contemplate were it not an obvious yielding to the necessity of breaking the interstate deadlock.

Many Water Boards

GOVERNOR MOORE moved in the right direction last week when he called a conference of the half dozen state bodies having to do with the control of municipal water supplies in New Jersey and the larger cities in the northeastern part of the State. If the conference results in nothing else it will be useful in calling attention to the number of bodies in some way concerned with matters affecting all the municipalities of the State and vital to its metropolitan section just now. Two of the bodies at the conference are temporary but for the time being important: The New Jersey section of the Tri-State Delaware River Treaty Commission and the Water Policy Commission. The latter has recently disapproved the proposed compact, as it now stands, and will soon report on a water policy for the State. Of the other four bodies three are supervisory and one—the North Jersey District Water Supply Commission—is constructing joint works for ten communities, including Newark and Paterson. The three supervisory bodies are the Board of Conservation and Development, which grants permits for the right to take the waters of the state and collects tolls for water used above a stipulated minimum; the State Board of Health, which has control over the sanitary quality of public water supplies; and the Sanitary and Economic Water Commission, a joint body composed of representatives of some of those named and one or two other state boards. Extended as this list is, it does not include one of the most powerful of the state boards having a hand in water supply matters in New Jersey—the Public Utility Commission, which controls the rates and general services (other than as they affect health) of private water companies. With so many agencies having a hand in the public water supplies of New Jersey, and with the Water Policy Commission about to make a report, a conference to promote co-operation was certainly in order. New Jersey may lead in its multiplicity of water boards, but some other states are in almost as bad a way and should give the matter consideration.

Put Snow on the Sidewalks

IN THIS period of heavy snowfall the following paragraph from a report on street traffic in Buffalo by W. B. Powell, consulting traffic engineer of that city, should be brought to the attention of every municipality. "It is recommended that the snow removal ordinance be so revised that the property owner be required to pile the sidewalk with snow on the edge next to the curb, but that he be forbidden to put any of it in the roadway. Furthermore, on those streets where it is impossible to entirely remove the snow from the street promptly, it should be provided that the snow from the vehicle roadway may be legally piled on the edge of the sidewalk next to the curb. On most city streets the proportion of width devoted to sidewalks is in excess of pedestrian demand, while the roadway width is considerably less than the vehicle traffic requirements. The street cleaning department should co-operate closely with the street railway company, so that every railway plow shall be immediately followed by a city motor truck plow that will push the snow clear to the curb line instead of leaving a ridge of snow near the tracks, thus forcing all motor traffic into the car tracks and resulting in serious delays to both classes of traffic." In most cities this reform would require a change of ordinances, in some merely an executive order. But the adoption of the suggestion, by whatever means, would remove an obsolete custom, and one which contributes more than anything else to the impediment to traffic that snow brings about.

Highway Association Needs a Job

IN TOTAL attendance and in attendance at the sessions for reading and discussing technical papers the convention last week at Syracuse, N. Y., of the Association of Highway Officials of the North Atlantic States was noteworthy. The subjects of the papers were capably handled. None of them received any considerable discussion from the floor. None of them opened new avenues in highway thinking. The authors stated familiar practice and experience and speculation in grade crossing elimination, road structure and construction, road maintenance, road materials and highway traffic. They did not specifically go into the problems of the states embraced in the group represented by the delegates. The consideration of the subjects selected was as broad and general as is roadbuilding. Let it be repeated, capable writers and road engineers prepared the papers, but any one of the papers would have had as direct appeal to a group of road engineers from the Gulf States or from the Rocky Mountain States as they had to the road engineers who came to Syracuse from New England, New York and New Jersey. So much for the facts.

If one thing is more certain than another it is that mere multiplication of associations of road builders is not needed. There are now the Association of State Highway Officials and the American Road Builders Association of national membership and embracing, together, every element of industry. No more country-wide organizations of road builders are justified. If it be conceived that these established associations are not living up to their opportunities, then let them be reformed. Setting up a competitive organization is neither good engineering nor good business. But there is justification for the local associations of road builders—the state association and the state-group association—to consider local problems. The roadbuilding field can well encourage greater development of state-group associations to consider intergroup problems and of state associations to fit the conclusions into intrastate operations. The justification of these local associations is that they be local and not national.

It is the error of the North Atlantic States Association that it has not yet discovered its logical place nor found its task. It is well to speak frankly. A convention and a program like that at Syracuse last week is not justified by the service it renders highway engineering. This year should see the association officials get down to a purpose and a plan of association work. The association needs a job.

Research in Railway Engineering

NEW studies of various phases of the practical and economic sides of railway engineering are becoming necessary with the increasing demands for high efficiency and economy in railway operation. Some progress has been made of late in research of this sort, but there remain very many opportunities for important study in both the technique and economics of railways. It is generally recognized that a number of the rules, formulas and accepted principles upon which the work of the engineer is based are more or less out of date and of doubtful applicability under modern conditions of construction, equipment and operation. Such rules and formulas are founded largely upon conditions of light wheel loads, light trains and engines of short wheelbase. How far they apply under modern conditions of heavy axle loads, 100-ton cars, six-wheel trucks, long engine wheelbases and 100-car trains is problematical.

Conspicuous examples of inadequate knowledge of fundamentals are in matters of curvature and grade, which apply not only to location and construction, and to maintenance work and expense, but are involved particularly in line and grade revision for the improvement of existing roads or divisions to meet changing conditions of traffic or operation. Reliance is still placed largely on tests and investigations made many years ago, and upon actual experience and observation, since theoretical methods now in use do not meet practical conditions.

Curves, it is a matter of long record, have an important relation to speed of trains and cost of transportation as well as to track maintenance, while very sharp curves have a relation to safety of traffic. It has been found that in a 10-year period, with no rail renewals on 1 deg. curves, the rails were renewed once on 2 deg. curves, once or twice on 3 deg., and twice on 4 deg. curves. Furthermore, track displacement by traffic has necessitated double or triple the amount of surfacing on the sharper curves, and there is a correspondingly greater wear on driving wheels, so that an engine working regularly over numerous sharp curves has a shorter period of service before it has to be sent to the shop for re-turning the tires. This is one of many features which the engineer has to consider in adopting his curve limitations.

Formulas for superelevation now used—or supposed

to be used—are based on experiments and studies long out of date. Rules as to elevation and widened gage are so diverse that they are of doubtful origin and value. Under present conditions, however, superelevation and gage of curves are matters of rule-of-thumb and trial-and-error rather than the result of scientific principles.

Much more needs to be known as to the principles and economics of grades and grade revision, even though those principles were definitely enunciated by A. M. Wellington nearly a half-century ago. C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry., recently called attention to the fact that in investigations as to any grade reduction project, the amount of traffic and the number and weight of trains are important factors. In the study of a given case it was found that it would be economy to spend $950,000 for each 0.10 per cent reduction in ruling grade, as against $220,000 for each mile of distance saved by line revision. In other words, each such unit of grade reduction was equivalent to saving 4.32 miles in distance, and in this particular case the possible reduction in grade was equivalent to shortening a 104-mile engine district to 57 miles. This specific information is valuable, but there are few published records or investigations of principles involved which are available to the engineer charged with the study of grade reduction problems to meet modern operating and economic conditions.

Since the ruling grades on many railroads and divisions are those adopted in earlier years for cheap construction and light traffic, Mr. Morse reiterates the Wellingtonian thought that it is pertinent to investigate the possibility and desirability of improvement either by constructing new trunk lines of low grade and light curvature, or by revising present lines to obtain the same results. An apt illustration of this alternative condition is the project for a new direct low-grade railroad across Pennsylvania, competing with and practically parallel with existing roads which have less favorable grades and curvature. Rapid movement of freight and low cost of operation are included among reasons advanced as warranting the construction of such a line. On the other hand, it is claimed that if such operating conditions were essential they could be obtained at much less cost on the existing lines, thus avoiding excessive capital investment and unnecessary reduction of the traffic and the income of the present roads.

In track structure, we have the one outstanding example of high grade and forward thinking research in the work of the Committee on Stresses in Track headed by Doctor Talbot. On the other hand, long and detailed investigation has been given to rail design and manufacture, in order to produce rails of high strength and wearing properties, qualified to meet the increasingly severe conditions of wheel loads and traffic, with results which are hardly comparable with the effort expended. Although the rail joint has long been recognized as a weak and troublesome point, little real study has been given to it and the innumerable designs and modifications proposed and tried have been based on general ideas rather than on scientific study. It is true that a direct step to reduce the number of these troublesome spots has been taken by increasing the length of rails, but the joint continues as an important element both numerically and as a source of trouble and expense. Now that the track stress committee has undertaken serious investigation of rail joints, some results may be expected upon which to base a permanent improvement or remedy. At the International Railway Congress, of 1925, mention was made of the desirability of a boltless joint; if a practical joint of this type should be developed, it would have the important effect of eliminating the more or less troublesome feature of bolt holes in the rails.

Practically the same conditions obtain as to rail fastenings, which are almost universally spikes nailing the rail base to the tires. However effective as fastenings while in good condition, they work loose, bend, pull out vertically and spread laterally under the influence of shock and vibration. Thus they not only form a weak spot in the track structure, but are a source of continual maintenance expense, besides being a prominent cause of decay and damage to the ties, with consequent reduction in their life and service. Screw spikes properly applied should be an improvement, but are not used extensively. Apart from tests of the grip or holding power of spikes and some limited trials of bolts and of modified forms of spikes, very little attention has been given to the study of rail fastenings.

There is a broad field for scientific study of means of providing continuous rail bearing through frogs, switches and crossings of track intersections. Research as to the practicability and economy of permanent roadbed and track construction, in order to reduce the continual cost of maintenance and to provide a better path for the trains, has been advocated already by F. H. Alfred, of the Pere Marquette R.R., who has also prepared tentative plans for such construction.

These are some of the technical problems on which more light is needed. Operation, and its relation to structure, is also open to improvement. The railway engineer in planning the building or improving of a line has to recognize that his railroad must be designed with regard to the loads and equipment which will operate on it, to the traffic which it is to carry, and to the efficient and economical handling of this traffic, with a view to adequate income for the owner. His structure is but one part of a machine for the manufacture or production of transportation. Hence the necessity for research into engineering matters which directly affect the efficiency and economy of operation—or transportation.

That this situation is becoming more widely recognized by the engineer is indicated by the considerable amount of attention and study which has been given by the American Railway Engineering Association to matters affecting economy of operation of the railway transportation machine. For example, recent reports have dealt with the following subjects: (1) Relation of train speed to cost of transportation; (2) cost of stopping and starting trains; (3) grade reduction compared with use of more powerful locomotives; (4) station and yard design in regard to operating efficiency; (5) economy of through routing solid trains; (6) unit measures of performance and cost in track work. For analytical and judicial study of such problems the engineer is peculiarly fitted by his training. The opportunities are many, the problems are numerous, and some of them are of pressing importance. Since they are of direct importance to the railways, the latter should assist freely with funds and facilities, as has been done already in regard to the track stress and rail design investigations.

Railway Construction: Recent and Prospective

Some Large Projects and Numerous Smaller Ones—Texas and Florida in the Lead—Connections Between Railway Systems—Competitive Issues in the East and Northwest

RAILWAY extension appears to be at last definitely on the up-grade, the record of 644 miles for 1925 showing a pretty steady rise for the past few years. From a high point of 5,600 miles of new line in 1906, there was a steady decline to less than a 1,000 miles per annum in the first years of the World War, followed by a rapid drop to little more than 300 miles in 1920 and again in 1922. In view of the succeeding upward trend and the indications of increasing activity, it is interesting to consider the extension work of the past year and that in prospect for the near future. As to prospective lines, however, it may be noted that some important roads are not at present prepared to state their plans for extensions, in advance of actual application to the Interstate Commerce Commission for the necessary authority, while there are numerous paper and promotion projects, too indefinite to mention.

Eastern and New England—Although this territory has a close network of railways, it includes one of the longest lines authorized by the Interstate Commerce Commission in 1925. This is the Quebec Extension Ry., 112 miles, to run west from Washburn, Me., across undeveloped country to connect with a branch of the Quebec Central Ry. just beyond the international boundary. This line is reported to be backed by the Aroostook Valley Electric Ry.

Short but important lines are those built to connect the New York Central low-level main line along the Hudson River with the new high-level bridge over the Hudson River, a little below Albany, N. Y., and a 5-mile cutoff built by the Delaware, Lackawanna & Western R.R. between Kingsland and Harrison, N. J., at a cost of about $2,175,000. The Pennsylvania R.R. has been authorized to build an important 7-mile line from Norfolk, Va., to Chesapeake Bay, near the mouth of Little Creek, but has not made plans for construction.

The big project of the New York, Pittsburgh & Chicago R.R. for a direct low-grade line from Easton, Pa., to the Pittsburgh district has been unfavorably reported upon by examiners of the Interstate Commerce Commission but the commission has not taken final action in the case. The Pittsburgh, Chartiers & Youghiogheny R.R., a freight line in the Pittsburgh district, proposes an 8-mile line south from Van Emman, Pa., to Eighty-four, on the Baltimore & Ohio R.R., but no early construction is in view. The Cambria & Indiana R.R. proposes to build a 5-mile extension from Revloc, Pa., in 1926; and the Conemaugh & Black Lick R.R. is authorized to build a 3-mile extension.

An important development in the three big coal railroad systems is the application of the Norfolk & Western R.R. for permission to build the 53-mile Guyandot & Tug River Ry., from Wharncliffe, W. Va., east to Gilbert, 10 miles, and thence to Elmore, 43 miles, on the Virginian Ry. A parallel project reported, but not confirmed, is that of the Chesapeake & Ohio R.R. to connect its line at Gilbert with the Virginian Ry. at Mullen's. A 12-mile extension of the West Virginia Midland R.R. from its terminal at Webster Springs, W. Va., eastward to Bergoo has been authorized.

Southeastern States—The unusual railroad development in Florida which resulted from the land boom there was described in detail in our issue of Feb. 11, p. 243 and need not be repeated here.

Closely bordering on the Florida work, is the 150-mile road to be built by the St. Louis-San Francisco Ry. to connect its Memphis-Birmingham division with Kimbrough, Ala., the northern end of the Muscle Shoals, Birmingham & Pensacola Ry., which it has acquired recently. In addition, the latter 143-mile line is to be rehabilitated at considerable expense; grades reduced to 0.75 per cent, alignment improved, bridges rebuilt, roadbed widened and ballasted, track relaid with 80-lb. rail, and terminals and docks at Pensacola improved. Another Alabama line is that now being built by the Mobile & Gulf R.R. for 33 miles from Buhl, on the Mobile & Ohio R.R., north to Fayette, on the Southern Ry. Part of this is the rehabilitation of a logging road. The Florence, Clifton & Paducah Ry. has applied for a permit to build from Florence, Ala., to Parsons, Tenn., and proposes a further extension to Paducah, Ky., about 225 miles in all.

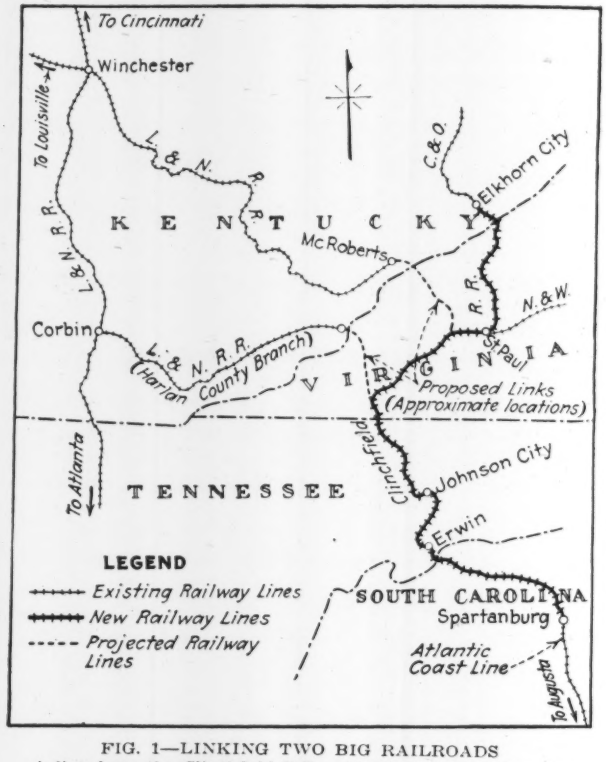


FIG. 1—LINKING TWO BIG RAILROADS
A line from the Clinchfield R.R. will effect a through route over the L. & N. and A. C. L. systems.

In the Carolinas, an important project not yet in definite shape is the Appalachian & Western North Carolina R.R., 125 miles, to be built by the state across the Blue Ridge, giving railway communication with the "lost provinces" on the western slope and also effecting a connection with western lines (*Engineering News-*

Record, Nov. 29, 1923, p. 878, and Aug. 28, 1924, p. 357). The Piedmont & Northern Ry., an electric line, proposes a 75-mile extension from Charlotte to Winston-Salem, N. C.; while the Carolina & Northeastern R.R. proposes to extend 20 miles from Lasker to Ahoskee, N. C. A 6-mile line is being built from Snow Hill to Hookerton, N. C., by the Snow Hill R.R.; and the Graham County R.R. proposes an 11-mile line southeast from Robbinsville to the Southern Ry. A 3-mile cutoff at Spartanburg, S. C., has been built by the Southern Ry., and the Hampton & Branchville R.R. expects to complete this year its extension from Smoaks to Cottageville, S. C., 20 miles.

FIG. 2—DOUBLE-TRACK ROCK CUT ON ILLINOIS CENTRAL NEW LINE

An important link between two large railway systems will be a line connecting the Clinchfield R.R. with the Louisville & Nashville R.R., Fig. 1, this physical connection being required by the Interstate Commerce Commission as a condition for authorizing joint control of the Clinchfield R.R. (277 miles) by the Atlantic Coast Line and the Louisville & Nashville. Surveys have been made for five alternative routes to the McRoberts and Harlan County branches of the latter road, but although the distance is not great the line will traverse a broken mountainous country in which it is not easy to find a location. Consequently, the L. & N. has applied to the commission for a modification of the above requirement and for authority to construct a shorter line from Chevrolet, Ky., to Hagans, Va., and for certain trackage rights.

Another south-central project, but one which is quite indefinite, is that of the Owensboro, Rockport & Chicago R.R. for a line from Owensboro, Ky., to Elnora, Ind., 84 miles, with a bridge over the Ohio River. This was disapproved by the Interstate Commerce Commission, but a rehearing has been asked.

On the Southern Railway System, a 17-mile cutoff has been built from Bull's Gap to Leadvale, Tenn., while a proposed line from Danville, Ky., to Jellico, Tenn., 120 miles, would give a direct northern connection with Knoxville. A 4-mile cutoff is proposed from Beverly, Tenn., to the new Sevier yard at Knoxville. Farther west, the Jackson & Eastern Ry. has built from Walnut Grove to Lena, Miss., 10 miles, and proposes this year to continue the line 40 miles to Jackson. From Bryant, Miss., on the Illinois Central R.R., the Mississippi & Schoona Valley Ry. is being built by the Bruce Lumber Co. to Bruce, 22 miles, where the company has a large sawmill plant. In Louisiana, the Southern Pacific Ry. (Louisiana & Texas Lines) is building a light-traffic 10-mile branch from Elks, La., to Milton and Youngsville, serving new sugar-cane plantations and sugar refineries. The Louisiana Ry. & Navigation Co. is building a line from Moreauville, to a point on the Mississippi River opposite Angola, La., about 14 miles, with a large bridge over the Atchafalaya River at Simesport. An incline for car-transfer boats is being built. This new line will replace the present route with car ferry from Naples to Angola. In 1925 the Missouri Pacific completed an 11-mile extension of its Eudora-Epps branch from Epps to Delhi, La.

Central and Northern—One of the few large lines under construction is that of the Illinois Central R.R. from Edgewood, Ill., to Fulton, Ky., 166 miles, utilizing the double-track Metropolis bridge over the Ohio River. This line, now more than half completed, will give a more direct north and south route with better grades than the present route by way of the single track Cairo bridge (*Engineering News-Record*, Dec. 24, 1924, p. 918, and March 5, 1925, p. 392).

The 18-mile cutoff of the Chicago, Burlington & Quincy R.R. between Frederick and Vermilion, Ill., is an example of relocation to secure low grade lines for heavy traffic.

Since a southern branch of the Chicago & Northwestern Ry. extends to Benld, Ill., within about 40 miles of St. Louis, it is proposed to extend it three miles to Staunton to connect with the Litchfield & Madison R.R., which is an electrically operated coal road entering the East St. Louis terminal district at Madison, Ill.

In 1925 the Alton & Southern Ry., a terminal road,

built a 4-mile extension from Granite City, Ill., to Mitchell, on the Big Four Ry. The Missouri Pacific Ry. built a 6-mile branch from Benton, Ill., to serve several coal mines, and has two other branches under construction: from Zeigler, Ill., to coal mines, 4 miles, and from Columbia to Krause, Ill., 3½ miles, to serve quarry developments.

An important line being built by the Pennsylvania R.R. is the 15-mile double-track cutoff between Bayard and Canton, Ohio, to give a more favorable line for heavy traffic (*Engineering News-Record*, July 17, 1924, p. 88). Work was commenced in April, 1925, and is about 66 per cent completed. Two Pennsylvania R.R. branches are a 3-mile coal line south from Powhatan, Ohio, and a 3½-mile line from Darlington, Ohio, to new glass works at Fultonham. The first was completed in 1924; the second is about 66 per cent completed. The Big Four R.R. has built a 3½-mile cutoff near Delaware, Ohio, and the Baltimore & Ohio is building a similar 11-mile line between Warwick and Sterling, Ohio. In 1925, the Pere Marquette R.R. completed a new connection from its line at Erie, Mich., to the Toledo Terminal R.R. at Hallett, Ohio. A 55-mile direct line between Durban, Mich., and Malinta, Ohio, is being built by the Detroit, Toledo & Ironton Ry., to avoid the present indirect route through Adrian, Mich.

To provide increased facilities for its fast through traffic, the Chicago, North Shore & Milwaukee Electric Ry. is paralleling its double-track line south of North Chicago, Ill., by a new double-track line farther west, from North Chicago to Niles Center, where it connects with an extension of the Chicago Rapid Transit Ry. This 18-mile line will be completed in 1926. Further north, the Chicago & Northwestern Ry. has built three logging branches of 8, 4½ and 4 miles from Beatons, Wakefield and Gogebie, Mich., respectively. The Wisconsin & Michigan R.R. has a 3-mile extension authorized. In Minnesota, the Chicago, Rock Island & Pacific Ry. has applied for a permit to build a 9-mile line from Clarke's Grove, Minn.; and the Chicago, Milwaukee & St. Paul proposes a 10-mile branch. The Minnesota Western Ry. expects to begin work this spring on an extension of its line from the present terminal at Lake Lilian, westward to Dawson, Minn., on the Minneapolis & St. Louis Ry., a total distance of 57 miles.

Texas and the Southwest—There has been considerable activity in both construction and promotion in Texas, where there are still opportunities for lines of considerable length, as will be seen by Fig. 3. In the northwestern section, the Santa Fé Ry. has completed its South Plains & Santa Fé Ry. line from Doud to Bledsoe, 65 miles, and it is credited with plans for further development. Another project is the Fort Worth, Denver & South Plains Ry., proposed by the Colorado & Southern Ry., which has surveyed its route and made application for a permit for lines extending from near Carey to Dimmitt, 130 miles, and south from Silverton to Lubbock, 65 miles. A third project in the same territory, for which also application is made, is the Texas, Panhandle & Gulf Ry., from Fort Worth (or Seymour) westward to Tucumcari, N. M., about 325 miles. The Quanah, Acme & Pacific Ry. has made application for a 27-mile extension from McBain, linking its line with the Santa Fé System at Floydada. Further east, the Jefferson & Northwestern has an extension authorized from Marietta north to the St. Louis Southwestern Ry., at Naples. In completing the Dallas Belt Line with a 9-mile link, to enable through freight trains to pass around the city, the Southern Pacific Ry. (Texas and Louisiana Lines) is providing grade separation at all highway crossings.

For some years there has been a project for a direct line south from San Antonio to the Gulf, at Brownsville, Tex., about 300 miles. A charter granted to the San Antonio & Rio Grande R.R. was forfeited by that company. Later the same project was taken up by the Rio Grande R.R., which has a 26-mile line from Brownsville to Point Isabel, but its plans have been abandoned for the present. Somewhat more definite is the San Antonio, Medina Lake & Western Ry., the company proposing to begin work this year on the line from San Antonio to Medina, 40 miles, as the first section of a 275-mile line northwest to San Angelo. The Waco, Beaumont, Trinity & Sabine Ry. is authorized to extend its Weldon-Livingston line southeast from Livingston to Beaumont, 80 miles. It proposes a further 20-mile

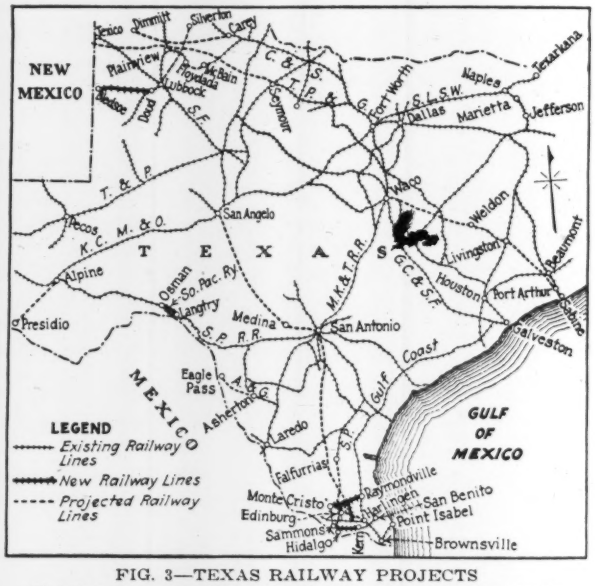


FIG. 3—TEXAS RAILWAY PROJECTS
Showing the connections of new lines, but not all existing railways.

extension to Port Arthur and also an extension northwest from Weldon to Waco, about 100 miles, thus giving a direct line between Waco and Port Arthur.

There is some activity along the Mexican boundary. The Gulf Coast Lines have under construction a link from Raymondville to Edinburg, 30 miles, with a 10-mile branch south from Hargill and another of the same length west from Allendale to a connection at Monte Christo. These lines are to be completed in 1926. Application has been made by the Southern Pacific (Louisiana and Texas Lines) for a permit to built an 84-mile extension from Falfurrias south to Hidalgo, on the border, with a 34-mile branch from Edinburg to Harlingen. This road is also building a 10-mile cutoff between Langtry and Osman, on its border line, saving 4½ miles in distance and 765 degrees of curvature. The Kansas City, Mexico & Orient Ry. has revised the surveys for continuing its line from Alpine, Tex., to the Mexican border at Presidio, but the company is not now in a position to undertake construction. The San Benito & Rio Grande Ry. has built a 31-mile link along the border from Kern to Sammons, and the Asherton

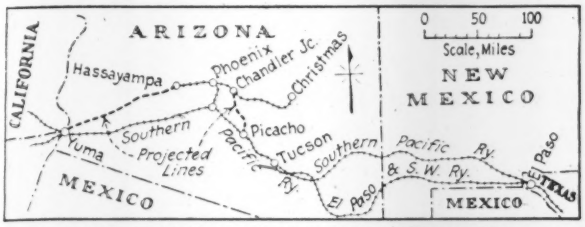


FIG. 4—SOUTHERN PACIFIC DUPLICATES ARIZONA LINE

& Gulf Ry. proposes a 60-mile extension from Asherton to Eagle Pass, on the border.

In Oklahoma, the Rock Island Lines will begin work this year on an extension east from Billings to Ponca City, Okla., 27 miles. The Beaver, Meade & Englewood has grading completed from Turpin to Hooker, Okla., while the time for completion of the line from Hooker to Des Moines, N. M., has been extended to the end of 1926. In adjacent territory the Santa Fé Ry. has three new lines; the Elkhart & Santa Fé, from Elkhart, Kans., to Felt, Okla., 50 miles, opened in 1925; the 10-mile branch from Marland, Okla., to the Three Sands oil field; and the Eldorado & Santa Fé, in Kansas, 42 miles, opened in 1924. The Kansas City Southern Ry. has made surveys for a 12-mile line from Leeds to Grandview, Mo. It has built a 3-mile revision between Braden and Reynolds, Okla., and a 5-mile extension from Lawton to Midland, Kans., this last connecting with a 6-mile line built from Baxter Springs to Midland by the Kansas, Oklahoma & Gulf Ry. The Oklahoma & Rich Mountain Ry. is building with its own forces a line from Page to Talihina, Okla., 35 miles. An extension of the Oklahoma Southwestern Ry. from Mounds to Okmulgee was proposed but postponed.

An important development in Arizona is the Southern Pacific's new lines from Yuma to Hassayampa, 120 miles, and from Chandler to Picacho, 50 miles. These lines, connecting with the branch on which Phoenix is located, will give a second route between Picacho and Yuma, with Phoenix thus situated on a main line instead of a branch. With this new construction and the El Paso & Southwestern line (now absorbed), the Southern Pacific will have practically two complete routes between El Paso and Yuma (Fig. 4), thus serving different districts and avoiding the necessity of double-tracking for the heavy traffic on the original line. A 10-mile extension has been built by the Central Arizona Ry., which is a logging line, and the New Mexico Central R.R. has been authorized to extend northwest from Torrance to Gallina, about 100 miles. In Arkansas, the Reader R.R. has completed its line from Reader to Waterloo, 23 miles. The project is still in abeyance for a combined Santa Fé and Burlington line from Carrollton to Mexico, Mo., forming a new route between Kansas City and St. Louis, and giving the Santa Fé an entrance to St. Louis.

Northwest and Pacific—A change in the railway system of Colorado will probably follow the completion of the Moffat Tunnel on the Denver & Salt Lake R.R. The situation is shown in Fig. 6. The extension of this road from its present terminal at Craig, Colo., to Salt Lake City, a matter of 300 miles, has been opposed by examiners of the Interstate Commerce Commission and so is not likely to be made for some years at least. A Utah company which has proposed to build east from Provo toward Craig probably will meet the same opposition from the commission's examiners. To meet this situation, however, and to make early use of the favorable line through the new tunnel, the Denver & Salt Lake R.R. proposes to build a 42-mile line south from the western portal along the Colorado River to Dotsero, on the Denver & Rio Grande Western R.R. This combination route would be about 590 miles between Denver and Salt Lake, as compared with the present 745-mile line of the latter road.

FIG. 5—TRACK LAYING ON SOUTHERN PACIFIC NEW LINE IN ARIZONA

An important project which started out boldly but met with difficulties is the North & South Ry., to extend from Casper, Wyo., north through Sheridan and on to Miles City, Mont., about 320 miles. At present there is a 40-mile line in operation from Illco (near Casper), Wyo., to Midwest, but nothing has been determined as to construction for 1926. The time for completing the road has been extended to December, 1928. An indefinite project is the Colorado Short Line, to run from Casper, Wyo., south to connect with the Denver & Salt Lake R.R. at Craig, Colo. In Wyoming, also, the Colorado & Southern Ry. has built a 6½-mile branch north from Wheatland.

A big project in the northwest is the low-grade relocation and 7¾-mile tunnel of the Great Northern Ry. in the Cascade range, on which work is now under way.

In Montana, this road is building a line from Scobey to Opheim, 50 miles. The Wenatchee Southern Ry., extending 80 miles southeast from the Great Northern Ry., at Wenatchee, Wash., is to be begun this year. The Northern Pacific Ry. completed in 1924 its 30-mile branch from Nichols to Colstrip, where it is getting coal from the Rosebud coal field. It is now building a 40-mile line in Idaho, from Orofino to Headquarters. In Washington, it has built from Elma to Shelton, with 7½ miles of new line and 8 miles of rehabilitated logging road. Projects include lines from Sidney, Mont., westward 50 miles, and from Ellensburg to Connell, Wash., but these are for future consideration. The Chicago, Milwaukee & St. Paul Ry. plans to lay track on a 12-mile extension of its Blackfoot branch, in Montana, the

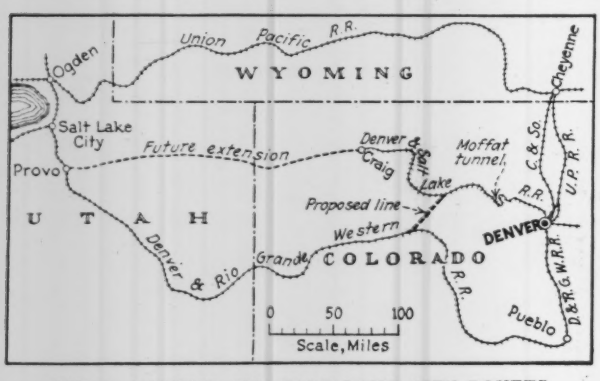


FIG. 6—DENVER AND SALT LAKE CITY ROUTES

grading for which was done some time ago. In Washington, the Longview, Portland & Northern Ry. in 1925 completed its 30-mile line north from Longview to Ryderwood. Construction is in progress on a 14-mile extension of the Cowlitz, Chehalis & Cascade Ry., west from Lacamas, Wash., to Mossy Rock. A 10-mile line up Gordon Creek, in Utah, built by the National Coal Co., will be taken over by the Utah Ry. as a branch line.

In California and Oregon an interesting development is the approaching completion of the 118-mile link in the 300-mile loop of the Southern Pacific Ry. between Weed, Calif., and Eugene, Ore., by way of Klamath Falls, giving a more favorable route than the older line along the coast. Near Weed the Southern Pacific is constructing a 24-mile cutoff as part of this general improvement. A proposed line southeast from Klamath Falls to Alturas, Calif., on the Nevada, California & Oregon Ry., and the changing of that road to standard gage to its connection with the main line at Hazen, will open a new route between Portland and the east. From Klamath Falls, the Southern Pacific also will develop northward by co-operating with the Oregon, California & Eastern Ry. in extending its line northward from Sprague River, Ore. This last enterprise has encountered some competitive difficulties, since the Hill interests have proposed to extend their Oregon Trunk Ry. south from Bend, Ore., to Klamath Falls, thus tapping this district for the Great Northern and Northern Pacific railways.

An important link completed in 1925 is the Union Pacific line from Rogerson, Idaho, to Wells, Nev. (94 miles), giving a direct route between Idaho points and San Francisco (*Engineering News-Record*, March 5, 1925, p. 390). It proposes a 4-mile branch from Cottier, Wyo., to the North Platte River, opposite Torrington. Extensions completed in 1924 include: Crane to Burns, Ore., 30 miles; Fort Collins to Buckeye, Colo., 17; Prunedale to Umapine, Ore., 4, and a 5½-mile spur from Iron Springs, Utah. Those of 1925 include the 28-mile Orchard-Boise loop, putting Boise, Idaho, on a through route instead of a branch; a 2½-mile loop at Nampa, Idaho, and a 10½-mile mining spur from Arden, Nev.

Turning to the southern part of California, the Western Pacific Ry. has made application to build a 12-mile branch from Villinger to Lodi, and a 13-mile branch (in conjunction with its subsidiary line, the Sacramento Northern R.R.), through the Holland irrigation district, about ten miles south of Sacramento, to connect with the San Francisco & Sacramento R.R. A 9-mile branch from the Sierra Ry. has been built by irrigation districts from McCormick to the site of the Melones dam, on the Stanislaus River, and the Southern California Edison Co. has built a 5-mile branch from Dawn, on the San Joaquin & Eastern Ry., to the hydro-electric development at Shaver Lake. The Yosemite Valley R.R. has built a 20-mile relocation between Merced Falls and Detwiler, as the old line will be submerged in the Hetch Hetchy reservoir. Improved terminal facilities at Los Angeles, Calif., are to be provided in connection with an 8-mile belt line of the Los Angeles Junction Ry. in co-operation with the Los Angeles Central Manufacturing District. The Mexicali & Gulf Ry. has under construction a 65-mile line from Calexico, Calif., to Bomba, which is the first part of a proposed 130-mile line to a point on the Gulf of California.

Quality, Progress and Cost of Winter Work

A REVIEW of the practicability of winter construction of buildings, with a comparison of its advantages and disadvantages, was given at the recent Chicago meeting of the American Construction Council by W. J. Lynch, vice-president of the Thompson-Starrett Co., contractors, Chicago. An extract from this paper is given below:

Nothing but competence is needed to produce a quality of work in winter equal to that obtained in summer. As to progress, there are few days in the year when it is too severely cold to work. Investigation of numerous jobs indicates that in recent years, in this climate, delay due to severe cold and heavy snows has not amounted to a total of a week's time, and it would be a rare case to amount to more than ten days. In thinking of weather delays in winter, equal delays due to rain in the milder seasons are overlooked, and in my opinion there is little difference, if any, in amount of lost time between winter season and milder season work. It is true that some divisions of the work cannot be completed as readily, such as removal of forms of concrete, which must remain in place for a longer period. On fair-sized operations, however, there are compensating advantages in that other branches of work are especially accelerated to minimize the inconvenience of the cold.

It is urged that the cost is prohibitive (1) because protecting the work in cold weather is costly, and (2) because the execution of the work itself is far more expensive. The methods of heating materials and of preventing freezing of concrete while being poured and afterwards are well known. But many people, including some contractors, lay considerable stress upon the increased cost which these precautionary measures add to the items of concrete and masonry. They fail to consider how small a ratio the cost of all precautionary winter measures bears to the total cost of the entire building. Further, they do not consider the other divisions of the building, in many of which are minor elements of economy, the cumulative total of which offsets any heating and protective work required for concrete and masonry.

Where the structure is entirely of reinforced concrete, the heating and protection cost is the greatest. Recent articles on this subject indicate that the cost runs from 1½ to 4 per cent of the total building cost. This is based on jobs totaling $50,000 to $250,000, the percentage decreasing with the size of the job. On a number of large reinforced-concrete jobs running from $1,000,000 to $3,000,000, the writer has found the cost has run less than 1 per cent and in only one case as much as 3 per cent. On steel-frame buildings with concrete arches, the ratio is considerably less, and on steel-frame buildings with tile arches it is still less.

Due to the practice of leasing in May in this territory, the demand for completion, prior to May 1, of large structures, which generally require a year's erection period, necessitates temporary heat for the interior work. The cost of temporary heating including that for construction materials, rarely exceeds 0.5 per cent of the cost of the structure. As to the unit costs of actually executing the physical work, a Milwaukee builder, referring to a reinforced-concrete building, makes the significant statement that while 60 per cent of all the concrete was poured in weather from zero down to —20 deg., the high cost of fuel and protection was offset by an increase in production of 10 to 30 per cent more production per day per man. However, it is doubtful whether others experience such favorable production results. The writer made a careful survey of the unit costs of concrete work, formwork and brickwork on five large jobs, which clearly showed that the average unit costs of winter operations are as favorable as, if not more so than, summer work.

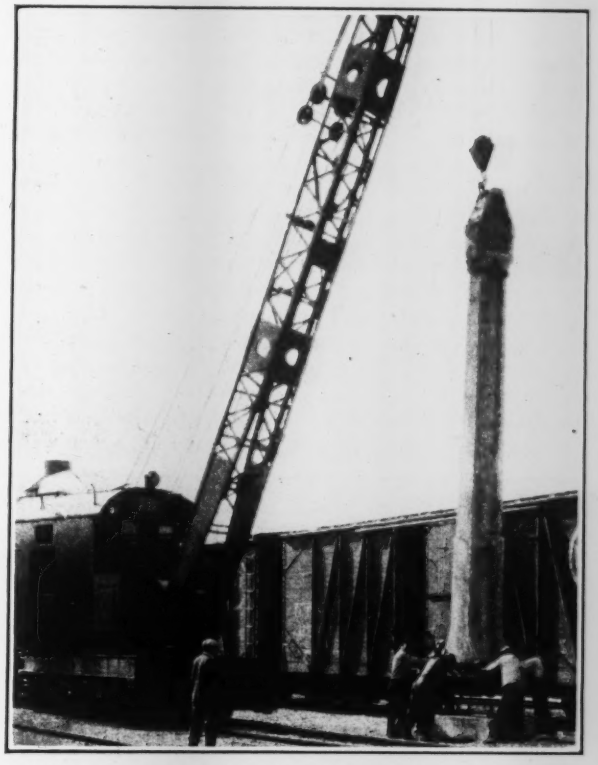
Precast Concrete Arches Carry Trolley Wires

New Idea in Electrification on Ford Railroad—Four Members Form Double-Track Span—Erected by Crane

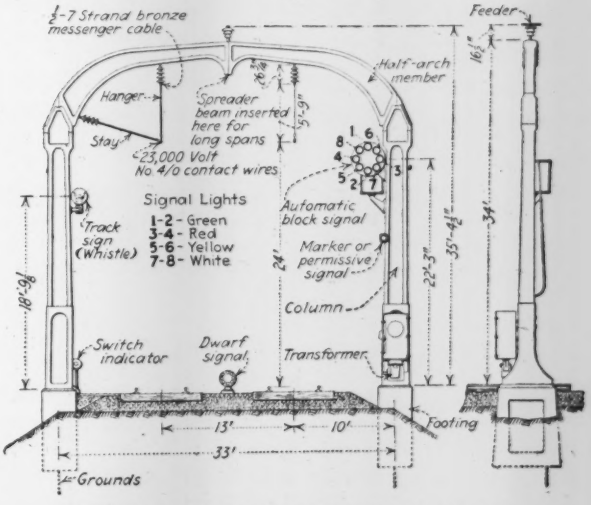
A NOVEL structural feature introduced in the electrification of the Detroit, Toledo & Ironton R.R. at Detroit, Mich., is the use of reinforced-concrete arched bridges or spans to carry the overhead wires, these taking the place of the usual structural steel bridges or steel poles. This electrification is being applied between Mossy Rock, Mich., and the Fordson terminal at Detroit, a distance of about 17 miles. A series of these arches on a four-track line is shown herewith.

The arch spans are built of precast concrete members of H-section. For the normal double-track spans there are two side columns and two arch segments, with a spacing of 33 ft. c. to c. of columns and a height of 34 ft. above top of rail. Where additional tracks require longer spans, a horizontal spreader beam is placed between the arch segments. The arches are spaced about 300 ft. apart. Those used to carry signals, as shown by the accompanying drawing, have smooth surfaces for the attachments and have inclosed conduits.

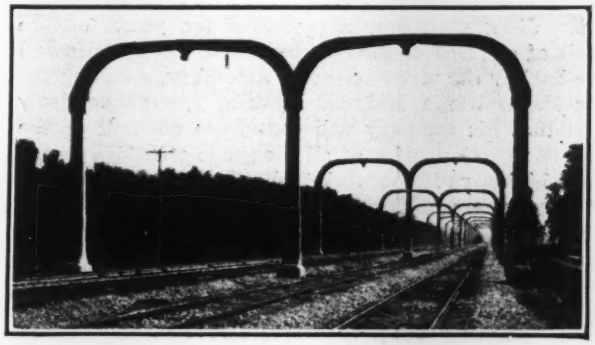
A plant for manufacturing the concrete units was established at the railroad's Rouge River yard and with a force of 60 men has a daily capacity of 22 members. Reinforcing rods are sandblasted, bent to shape and moved mechanically to platforms where men assemble them in skeletons which are spot-welded together, thus eliminating the use of tie wires. Forms with the reinforcement secured in place are carried by monorail hoists and placed on flat cars which are run to the concreting plant; after standing 24 hours in the yard, the forms are stripped and a coat of cement grout is applied to the concrete. The units are then moved first to a



SETTING PRECAST COLUMN FOR TROLLEY WIRE ARCH



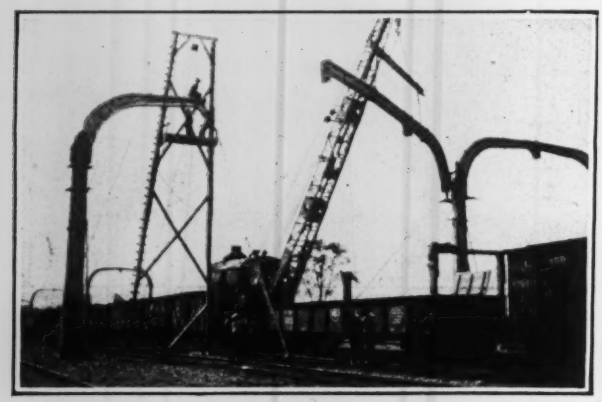
CONCRETE SUPPORT FOR TROLLEY WIRES
Showing attachment of track signs and location of block and dwarf signals.



CONCRETE TROLLEY WIRE ARCHES, D., T & I. R.R.

curing oven where they are steamed at 90 to 120 deg. for 24 hours, and then for a similar period to a drying oven of about the same temperature. Small trucks on rails then carry the units to the storage yard, where they are held for at least 18 days, after which locomotive cranes load the units on railroad cars by means of rubber-faced tongs attached to a swing beam on the crane hoist. Columns weigh about 5½ tons and the half-arches about two tons each.

After engineers had staked out the foundations, a work-train crew made the excavations and set the anchor bolts, electric cables and reinforcing. Another crew poured the concrete, which was left to set for 24 hours before removing the forms and then for at least five days before placing the columns. With a train load of columns on one track and a locomotive crane on the other track, the columns were swung into position and set over the projecting anchor bolts. A 2-in. space was



ERECTING LONG-SPAN ARCH FOR TROLLEY WIRES

left for steel wedges to plumb the column, after which the space was packed with cement grout.

Arch members were handled on a similar train. For an ordinary span, the two members were assembled and bolted together on a car having a working platform, the completed unit being then set in place by a locomotive crane and bolted to the columns. For long spans having the spreader or extension beam at the middle, one half-arch was set in place on a column, bolted up and supported by a falsework bent. The extension beam was bolted to the other half-arch and this unit was swung into place, while men on the falsework bent bolted the spreader to the first half-arch. Finally, the messenger and trolley wires were strung by a work train having flat cars for reels of wires and box cars on which was a high platform or trestle for the workmen.

Color-position automatic signals are installed: two green lights in a vertical line indicate "proceed"; two yellow lights in a diagonal line, "proceed with caution to next signal"; two red lights in a horizontal line, "stop." At some points there is a marker lamp placed below the main signal, under control of the train dispatcher and used as a permissive or calling-on signal. When this signal is displayed it shows an amber light and indicates that a second train may pass the red or "stop" signal and proceed cautiously to the next signal.

The concrete arches, electric wiring system and signal system were designed by the engineers of the Detroit, Toledo & Ironton R.R.; and all construction and erection work was done by company forces.

Maryland Negotiates Agreement for Crossing Elimination

Arrangements Completed with Three Leading Railways for Ten-Year Program of Grade Crossing Elimination on State Roads

By John N. Mackall
Chairman, State Roads Commission, Baltimore, Md.

ONE of the really big problems confronting the nation is the separation of highway and railway crossings at grade. Before much progress can be made toward the physical elimination of crossings, it is necessary to bring the public to a realization that elimination (1) is a problem which must be solved and also is (2) not the sole responsibility of the railways or of the highways. It is the joint problem of the highways and of the railways.

It can perhaps be argued that where the highway existed first and the railway crossed it later, the railway has the responsibility of eliminating the crossing. This argument loses a great deal of its force, however, when we consider that the railroads proceeded in an orderly and legal manner and with the approval of everyone, to cross the highway with their tracks at grade. No one was particularly interested in separating the lines because the grade crossing really presented no menace. The travel over the highways was before the motor age and consequently suffered no great danger and no great hardship. As traffic increased, various forms of safety devices were established to take care of the increased hazard, but there have been sufficient of these established to prove that the only real answer to the problem is grade separation. The railroads, certainly in the east, were responsible for the establishment of most of the grade crossings, but the railroads were not responsible for the changed traffic conditions, and the sooner the problem is recognized as a joint one the sooner some progress will be made toward solving the problem.

Financing the Elimination—At the present time there is no legislation fixing the financial responsibility for grade-crossing elimination, and there is no agency in Maryland which has the authority to compel their elimination. All crossings which have been eliminated on the state highways have been financed substantially on the cost basis of 50 per cent by the highway department and 50 per cent by the railroad.

Maryland has just obtained a substantial agreement with the Pennsylvania Railroad System, the Baltimore & Ohio Railroad Co. and the Western Maryland Railway Co., that they will pay one-half of the cost of eliminating all the grade crossings on state highways in the state, distributed over a period of ten years, on the basis of one-half of the cost by railroad companies and one-half by the state. General Atterbury, speaking for the Pennsylvania Railroad System, has unqualifiedly said that his company will contribute one-half of the cost of the elimination of all the grade crossings on the state highways if the work is distributed over a period of ten years. Charles Galloway, operating vice-president of the Baltimore & Ohio Railroad Co., has said that his company is willing to pay one-half of the cost of eliminating the crossings on this company's lines if it is able to finance it, and he seems very hopeful of this. Maxwell C. Byers, president of the Western

Maryland Railway Co., said that he believed that the 50-50 distribution of the cost between the railroad and the public is a fair distribution and that his company is in favor of the elimination of grade crossings and believes that their elimination is essential, and that while the company does not now see where the funds are coming from, it believes that it will be able to proceed when the time comes.

Practically all of the grade crossings in Maryland are located on the lines of these three companies. The other companies with one or two grade crossings have not been approached, but it is believed that they will be willing to proceed; certainly, if the legislature passed the necessary act and provided the necessary funds, public sentiment would force the other railroads to proceed if the law did not. There seems to be little or no doubt that an act of the legislature offering to pay 50 per cent of the cost and requiring the railroads to pay the other 50 per cent would be enforced.

Benefit Tax or Bond Issue—The sum involved in all the grade crossings in Maryland is something like $20,000,000. The raising of one-half of this sum by the public becomes necessary to the beginning of the project. Taxes cannot be made popular. The best we can hope to do is to make them equitable. It is perhaps a reasonable conclusion that the public, while not liking to pay taxes, does not particularly object to paying any equitable tax. The sole beneficiary of the grade crossing plan is the automobile. It is obvious then, that the automobile should pay the cost of the state's share of the program.

A tax of 1c. per gallon on motor fuel will provide a sum sufficient to eliminate all of these crossings over a period of ten years.

There are advocates of the bond issue plan against the pay-as-you-go plan. This seems to be wholly illogical. Bond issues are certainly justified for public improvements which are to last over a long period of time, but bond issues are much more expensive than the pay-as-you-go plan, and should only be employed on projects which cannot be financed from current receipts. Since the work is to be distributed over a period of ten years, little is to be gained by the bond issue plan. If the work was to be done in one year, then it would be beyond the ability of the people of Maryland to raise $10,000,000 in one year except by the bond issue plan.

In Maryland, under the present constitution, a bond issue may run for but fifteen years. The rate of interest on state bonds is now 4½ per cent and this is perhaps as low a rate as can be figured over a period of ten years. One million dollars by bond issue costs $1,432,203.34. It seems quite obvious that Maryland should not pay $1,432,203.34 to obtain $1,000,000 if it is able to raise $1,000,000 annually. That it is able to raise this sum goes without saying because the road service Maryland is rendering to its citizens today is at a less tax on motor vehicles than almost any other state in the Union. The registration fee for automobiles is but 32c. and the motor fuel tax but 2c., making the average price per car of less than $15 per year.

Voluntary Offer of Railroads—The most interesting thing about the whole plan is that three of the big railroads of the country have voluntarily gone in on a comprehensive plan to eliminate grade crossings. They have done it without any law which could compel them, and this, it seems to me, is a clear indication that these railroad officials realize that they cannot maintain cordial relations with the public if many people are going to be killed annually at railroad crossings.

The plan which has been consummated originated so far as we know at an informal conversation at a dinner between General Atterbury of the Pennsylvania R.R. and John Dennis, state treasurer of Maryland. They were informally discussing a very distressing accident which occurred at Lutherville near Baltimore on the Pennsylvania R.R., when four young persons were killed outright in a collision between a locomotive and an automobile. General Atterbury then voiced the opinion that the grade crossing presented an intolerable situation which it was necessary to cure. Mr. Dennis suggested that if he felt this way about it, it might be well to have a conference between General Atterbury and me. This conference was arranged and General Atterbury said that he would be glad to have the Pennsylvania R.R. pay one-half of the cost of the elimination of grade crossings in Maryland if the Maryland authorities could raise the other half. General Atterbury said further that he was glad to make the start in Maryland because there was neither bad legislative nor a bad public sentiment situation to handicap the successful culmination of the project.

It would seem that it might be more difficult for the railroads to raise their 50 per cent than for the authorities in Maryland to raise the public's 50 per cent. The railroad revenues are limited and to a large degree fixed by the Interstate Commerce Commission. They must either increase their revenues or decrease their expenditures if the added burden is to be carried. It is interesting to note, however, that the Interstate Commerce Commission has ordered in some cases and is about to order in other cases the installation by the railroads at their expense of automatic train control. Whether automatic train control has been satisfactorily worked out or not I do not know and it is really beside the point. The fact remains that there are perhaps a hundred persons killed at grade crossings to every person killed in train wrecks, and if this proportion is likely to continue, it would seem the part of wisdom for the Interstate Commerce Commission to permit the diversion of funds which it proposes to order expended for automatic train control to grade crossing elimination. The sum which is necessary and will be expended for automatic train control, if matched with an equal amount from the highway authorities, would go a long way toward eliminating all of the grade crossings in the United States, and would certainly eliminate those on which 90 per cent of the traffic now goes.

There is perhaps no industry which would spend a given sum to make its workmen safe from one cause when the expenditure of an equal sum would save 100 more lives from another cause. It is possible that the railway officials expect some such result as this to come about from their voluntarily going into the grade crossing separation matter. If so, it was not brought into the discussion, and is in no way a part of the agreement between the state authorities and the railroad authorities, but is well worth the consideration of all people as a means of bringing to an end the horrible daily toll of deaths at grade crossings.

Sennar Dam on the Blue Nile in Egypt Completed

Earth and Masonry Structure Nearly Two Miles Long—Water Diverted to Extensive Irrigation System

AS THE beginning of an enormous irrigating scheme in Egypt the Sudan Government has completed recently a dam across the Blue Nile, a dam which takes its name from the neighboring town of Sennar. It is located about 170 miles south of the point where the Blue and White Nile join to form the main Nile River of lower Egypt and nearly 800 miles south of the Aswan (Assuan) dam across the latter stream. The major portion of the triangular section of country lying between the two rivers from their junction south toward Sennar is a great plain called the Gezira Plain, roughly

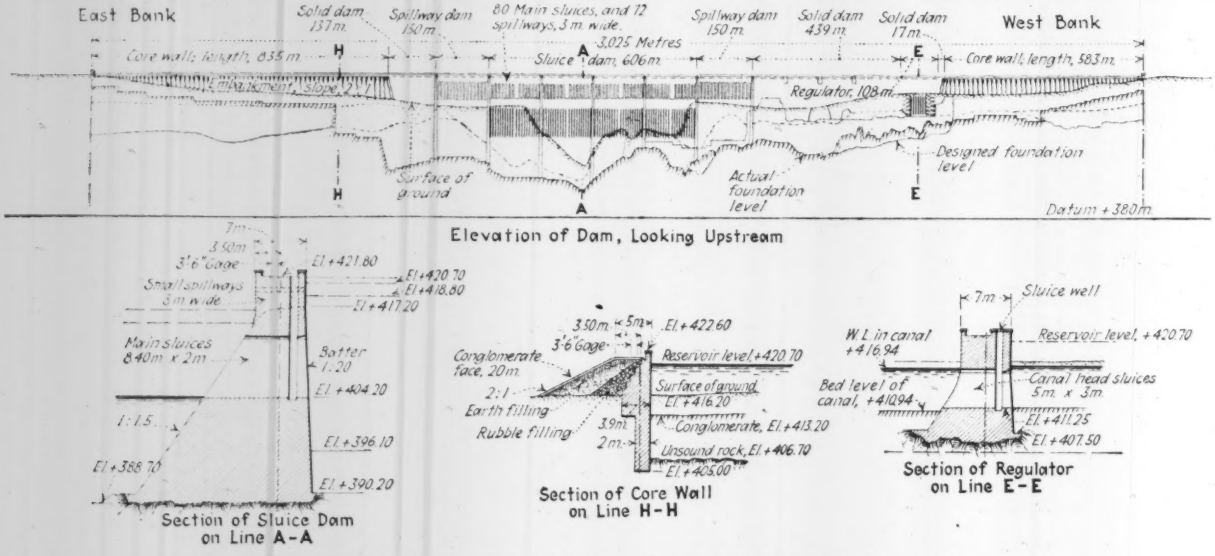


FIG. 1—ELEVATION AND TYPICAL CROSS-SECTIONS, SENNAR DAM

10,000,000 acres in area, of which the central portion, 3,000,000 acres, will grow cotton, under irrigation.

Early Studies—When the possibility of growing crops in a certain portion of the Sudan was first considered a small portion of the Gezira Plain was prepared for irrigation and water was pumped from the Blue Nile. The results of these tests were so satisfactory that, in 1913, preliminary work was begun for a dam across the river at Makwar, near Sennar, a point where the conformation of the river valley and the subsurface conditions made the construction of a large dam possible. Preparations also were made for the construction of a main irrigation canal extending from the dam northward down the valley into the plain, a distance of some 70 miles, but actual construction of both the dam and canal hardly had been begun when the War put an end to work on the dam and greatly reduced the amount of work upon the canal.

Construction of the Dam—Actual construction of the dam was started in April, 1921, the structure was completed in July, 1925, and officially put into service in January of this year. During this time work was carried on during about eight months of each year, the floods holding up work from June to mid-October.

The dam is 9,925 ft. long (3,025 m.) and is made up of a central portion of masonry, of gravity section, and two end portions built partly of masonry and partly of earth fill. The general dimensions are given in Fig. 1. The height, channel bottom to spillway elevation, is 68 ft., and the overall height at the point of deepest foundation is 130 ft. The total masonry content is approximately 425,000 cu.m. (552,000 cu.yd.) as compared with 920,000 cu.m. of masonry in the Aswan dam.

The central portion of the masonry dam is provided with 80 low-level sluiceways 27.5 ft. high by 6.5 ft. wide with their sills at about the level of the river bottom, and 72 smaller high-level sluiceways 9.8 ft. wide and 6.6 ft. high. These upper sluiceways have their sills at the elevation of the spillway crest and differ only from the openings on the spillway section of the dam in that they are 9.8 ft. (3 m.) wide whereas the openings on the spillway section are 16.4 ft. (5 m.) wide and are not provided with sluice gates. This large number of control gates is made necessary by the floods which come down the Blue Nile, floods which cause the annual inundation of the lower Nile. The flow of the White Nile is regulated to a large extent by the lakes at its headwaters. The flood sluices on the Sennar dam are operated from a bridge across the top of the dam which also will carry a 3-ft. 6-in.-gage railway.

The masonry portion of the dam is built of rubble laid up, for the most part, in mortar made of 1 part "red cement" and 4 parts sand. The red cement is a mixture of 70 per cent portland cement, manufactured in a mill set up near the site, and 30 per cent burnt clay, the burnt clay being added to the cement clinker in the final grinding. This red cement was used for all work except the surface facing and the dressed ashlar used in the sluice openings, and produced a very satisfactory job. The mosaic surface work and the cut stone in the sluices were laid in portland cement mortar.

The dam rests on a foundation of gabbro, a hard rock heavier than granite, for its entire length. Granite rock for the structure and limestone for the cement were obtained from quarries opened in the neighborhood.

Rubble masonry was used in preference to mass concrete on account of the high cost of cement and the cheapness of common labor. Some 350 skilled masons

were employed when the construction was in full swing and the whole work, including the canals, had a labor force amounting to 20,000 men.

Regulator gates consisting of 14 sluiceways for the canal are built into the dam at the west bank. These

FIG. 3—DOWNSTREAM FACE OF DAM, HALF THE INTENDED HEIGHT

will pass sufficient water to irrigate 1,000,000 acres of land, but as the present canal serves only an area of 300,000 acres 7 of the gates have been blocked, temporarily, with concrete. At the present time the Blue Nile is much more subject to flood than the White Nile which, as stated above, is regulated to a certain extent by the large lakes at its headwaters, but plans are now being developed for the construction of storage reservoirs in the headwaters of the Blue Nile in order to increase the quantity of water that is available for irrigation.

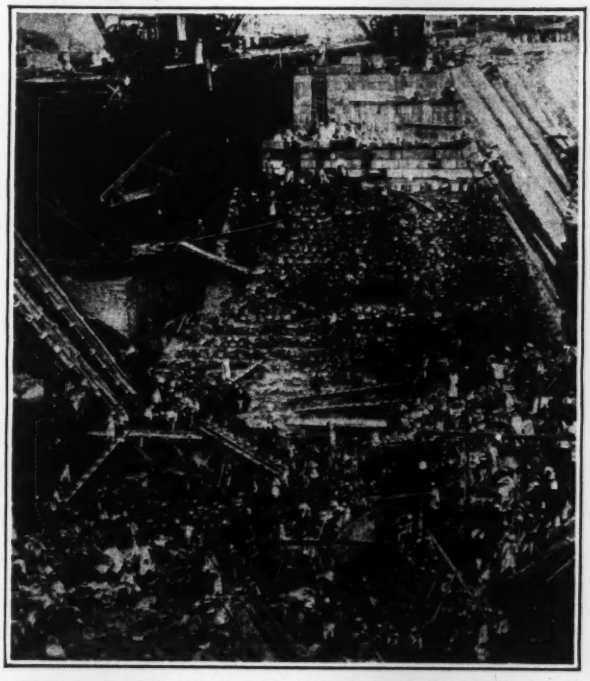


FIG. 2—NATIVE LABORERS WORKING ON THE DAM
The red color of the mortar registers as black on the photographic plate giving the masonry a dirty look.

The Irrigation Canal—The main canal runs roughly parallel to the river for a distance of 35 miles before it reaches the irrigated area, and then continues with numerous branches for a further distance of 35 miles. In its largest section the canal is 85 ft. wide at the base, has side slopes of 1:1, and a water depth of approximately 11 ft. The fall is 7 in 100,000 and the discharge 2,824 sec.-ft. The total length of all canals is 775 miles and the total earthwork 20,000,000 cu.yd. All of the excavation of the main canal and some in the branch canals was done with dragline excavators, of which 24 were used, including 4 with 5-cu.yd. buckets and 4 with 4½-cu.yd. buckets. A total of 12,600,000 cu.yd. of material was handled in this way. The cost of the entire project was approximately $43,000,000.

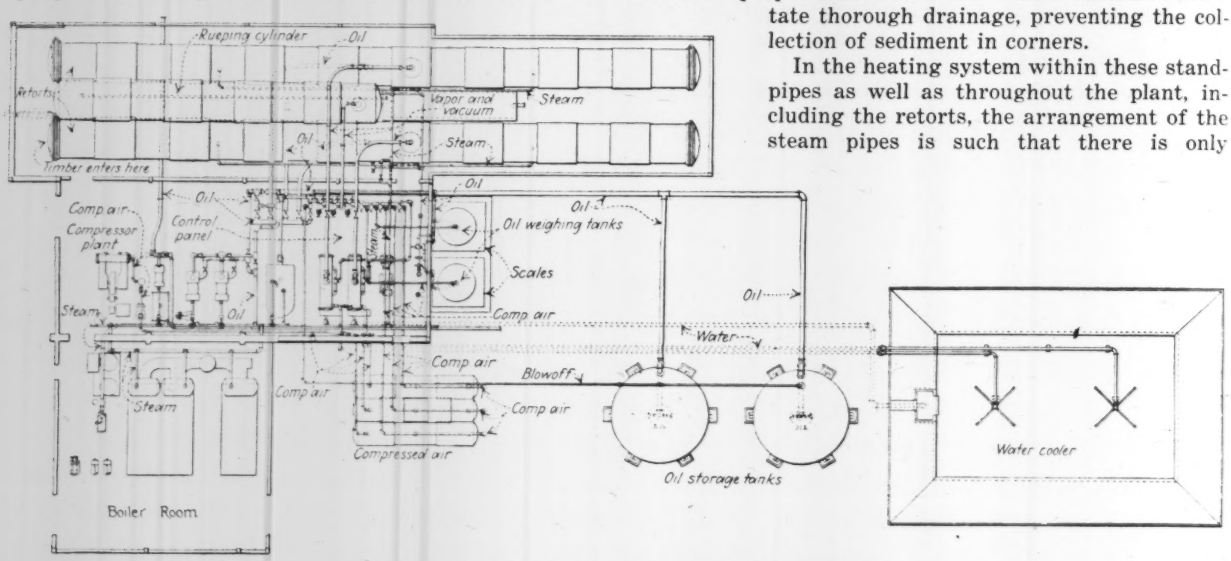
Staff—The firm of Coode, Fitzmaurice, Wilson and Mitchell, of Westminster, England, acted as consulting engineers to the Sudan Government on both the dam and canal construction and S. Pearson & Son, Ltd., were the contractors except during the early part of the work. Sir Maurice Fitzmaurice, of the engineering firm, earlier in his career acted as resident engineer on the Aswan dam.

The information upon which this article is based was obtained from *The Engineer*, London, from the annual report of the Ministry of Public Works, Egyptian Government, and from A. W. Robinson, consulting engineer, of Montreal, who has been connected with the project for a number of years.

New Creosoting Plant for Southern Pacific at Oakland

Old Plant in Service 38 Years Replaced by Two 8x132-Ft. Retorts—Processes and Periods of Treatment Differ for Ties, Timbers and Piling

SINCE 1887 practically all of the creosoted timber used by the Southern Pacific R.R. in the vicinity of San Francisco has been treated in a small two-retort plant located in the West Oakland yard on San Francisco Bay. There is at least one pile structure still in service in salt water for which the piles were treated in the old plant in 1889. The amount of creosoting which the company has required in western territory has recently greatly exceeded the capacity of this old plant and a much larger modern plant designed by company forces has just been built close to it. In the design of the new plant the objective was a layout and arrangement such that the operating cost would be kept to a minimum by the maximum speed and efficiency in handling timber. The total capacity of the creosoting plant on a per annum basis is 5½ million ft.b.m., of timber and piling and 810,000 ties averaging 3½ cu.ft. content.



PLAN SHOWING ARRANGEMENT OF TREATING PLANT

The adoption three years ago of creosoted ties as standard for all track construction except where mechanical wear is the determining factor in tie life has greatly increased the demand on the company's creosoting plants. On practically all new or renewed track, creosoted ties are now used. This refers to the Pacific division of the Southern Pacific system, which comprises 12,868 miles of single track. Three creosoting plants are now operated in this territory by the railroad, namely, at West Oakland and Wilmington, Calif., and at Alamogordo, N. M. A fourth plant is being built at Eugene, Ore.

The layout of the new plant at West Oakland provides for the delivery of oil or timber by either rail or water. Ordinarily timber comes in by rail and oil by water. Buying creosote oil to advantage frequently necessitates the purchase of an entire ship's cargo at one time and hence a 1,250,000-gal. oil storage tank of standard design has been provided in that part of the plant most convenient to the Oakland estuary. Close to this storage reservoir are two 100,000-gal. mixing tanks in which fuel oil is mixed with creosote for those treatments which do not use pure creosote.

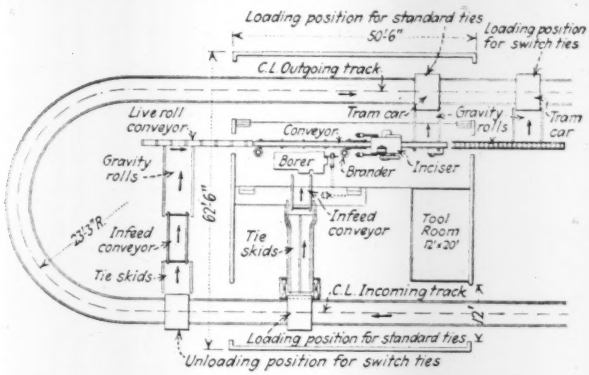
Still closer to the retorts are two 50,000-gal. conical-bottom working tanks of the same design and arrangement. One of these is used exclusively for pure creosote and the other for mixture. The steam-heating pipes for these tanks are in the 4-ft. standpipes below the tank proper into which the conical bottoms facilitate thorough drainage, preventing the collection of sediment in corners.

In the heating system within these standpipes as well as throughout the plant, including the retorts, the arrangement of the steam pipes is such that there is only one threaded joint per pipe not accessible from the outside and that is the connection between individual pipes and the manifold from which they are supplied. The steam pipes leading from the manifold are 1 in. in diameter and only welded joints are used for their full length. Instead of elbows and separate return lines the return is around the 1-in. line inside of a 4-in. line blanked off at the outer end. All of the 4-in. joints are likewise welded. Separation of the 1-in. and the 4-in. lines is secured by spiders which center the 1-in. pipe without obstructing flow.

The retorts are 8 ft. in diameter to accommodate standard-gage trams and are 132 ft. in length. Above and between the two retorts, which are mounted side by side, is the overhead operating tank or Rueping cylinder which has a capacity of oil equal to that of either retort less the volume of a charge of timber.

Control of the injection of the preservative is by means of pressure measuring tanks mounted on scales close to the pump room where the oil is weighed as it is injected or returned in the form of "kickback" when the pressure is released.

In the matter of creosote treatment, Douglas fir, which is treated in this plant practically to the exclusion of all other varieties of timber, is regarded as a



ARRANGEMENT OF EQUIPMENT IN TIE MILL

refractory material, and adaptations of the treatment processes have been made accordingly.

The Boulton full-cell process of boiling under vacuum is used for structural timber and piling, while the Rueping process is used on ties. In the former process nothing but pure creosote is used while in the latter this company has found a mixture of 70 per cent creosote and 30 per cent fuel oil to give best results. The addition of an asphaltic base fuel oil has the advantage that it mimimizes brooming and splitting of the tie in service.

In the Boulton process the preliminary bath is continued from 10 to 24 hours, according to the size and condition of the timbers being treated, the bath being terminated when the condensation coming off in the form of vapor does not exceed 0.1 lb. of water per cubic foot of timber treated per hour. The temperatures range up to a maximum of 220 deg. F. Normal atmospheric pressure is kept on the tanks in this treatment during which only enough of the preserving fluid is put in to entirely cover the timber.

After this preliminary period comes the pressure treatment with temperatures decreased to perhaps 170 deg. F. but with pressure raised to 175 lb. per sq.in. which is continued (for a period determined by experience) until the final retention specified has been obtained. Usually this varies from 8 to 14 lb. per cubic foot. After draining, the retorts are subjected to a final vacuum of 20 in. for one-half hour to recover the drip and surface oil.

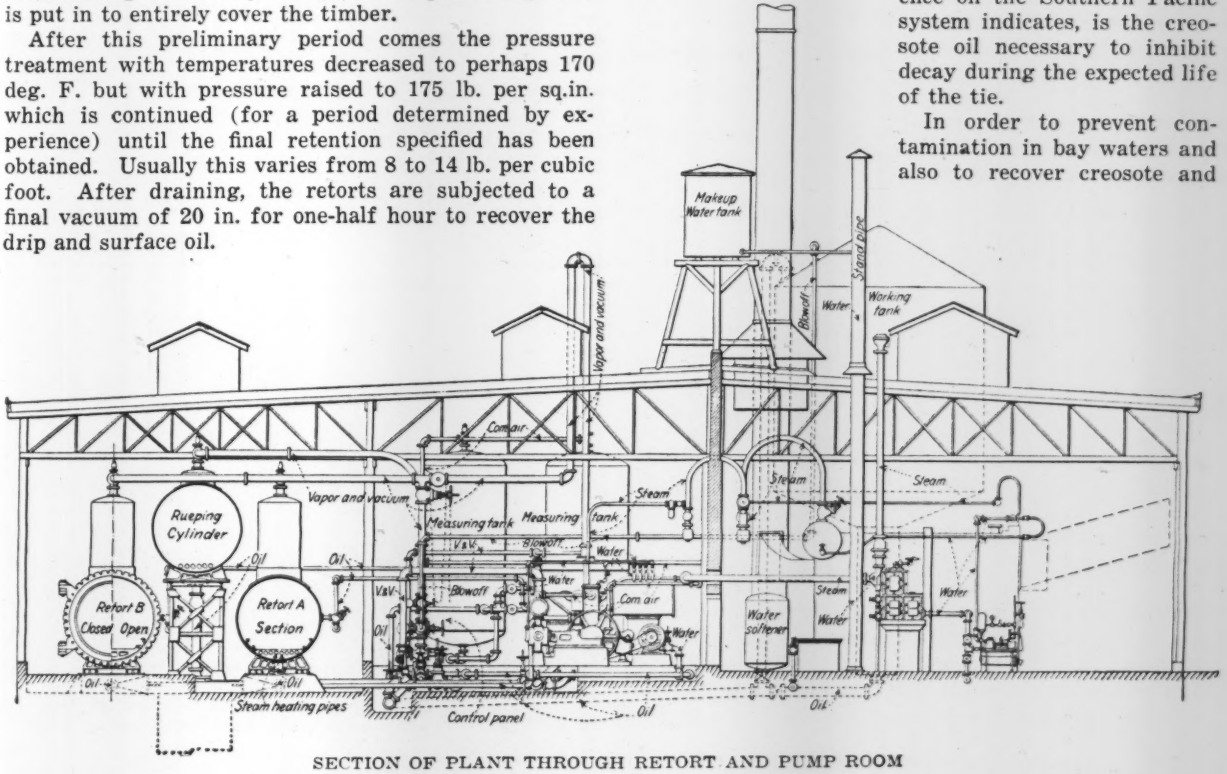
In treatment of ties under the Rueping process the intent is to coat the cells of the wood rather than to fill them with the preservative, and hence the retention of oil is much less than under the processes just described. The tie treatment, like the other, is divided into preliminary and pressure periods although the treatment in each period is somewhat different.

In the Rueping process the preliminary bath is at temperatures of 180 to 200 deg., varying over this range in proportion to the amount of seasoning, and the total time of treatment varies from 15 to 20 hr. During the first five or six hours the retorts are under a vacuum of about 15 in., after which this is increased to 20 in. and continued until the condensation does not exceed 0.1 lb. of water per cubic foot of timber, as in the other process.

The greater difference in the tie-treating process comes in the second period, as follows: After the preliminary bath the oil is blown out of the retort to the overhead tank and the wood is subjected to air pressure of say 80 lb. per sq.in. in order to force compressed air into the cells. With this same pressure still on, oil is allowed to flow back into the retort and pressure on the oil is then increased up to a maximum of 200 lb. per sq.in., while temperatures up to a maximum of 200 deg. F. are maintained for 1½ to 2 hours. The oil is then taken out and a quick and final vacuum as high as can be maintained (above 22 in.) is continued for one to two hours.

The theory of this treatment is that the preliminary bath softens the fibres which are then filled with air and expanded after which the oil is forced in in quantities ranging up to 11 lb. per cubic foot. The method of withdrawal reduces this amount to a final retention of approximately 7.1 lb. per cubic foot. With the 70 to 30 mixture used for ties this 7.1-lb. retention means 5 lb. of creosote and 2.1 lb. of fuel oil and this, experience on the Southern Pacific system indicates, is the creosote oil necessary to inhibit decay during the expected life of the tie.

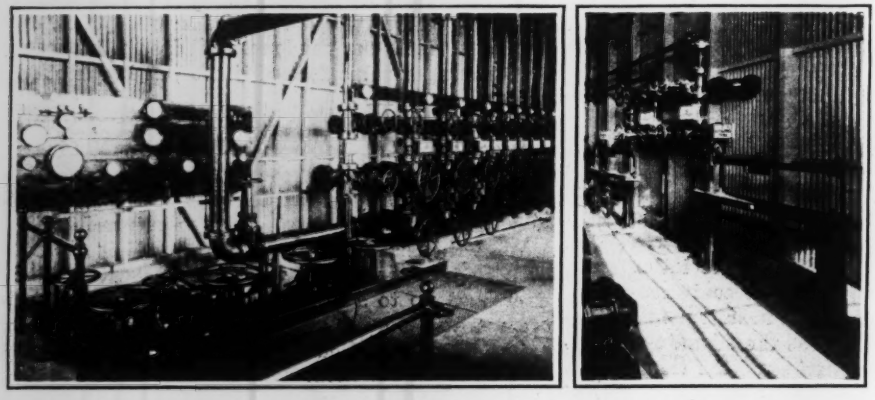
In order to prevent contamination in bay waters and also to recover creosote and



SECTION OF PLANT THROUGH RETORT AND PUMP ROOM

oil that have become mixed with water in the process of treatment, an oil separator operating on the specific gravity principle has been provided. This consists of a concrete tank about 8x30 ft. in plan and 8 ft. in depth with transverse concrete baffle walls 4 ft. apart. This tank is built below ground level at a convenient corner of the pump house.

Steam for the heating coils and also for power is provided by three oil-fired 120-hp. cross-drum water-tube boilers. A water softener treats all water used in the plant for boilers as well as for circulating and cooling water. The cooling pond serves also as an emergency reserve storage for treated water. The electrically driven air compressors work to a 250-lb. pressure and store compressed air in three receivers, totaling 1,470-cu.ft. capacity. Because of the danger of corrosion in salt water, permanent piping around the plant not embedded in concrete is laid in redwood troughs which are filled with tar, the plan being to provide a protective coating not less than 1 in. thick entirely around the pipe.



CONTROL PANEL AND SCALES FOR WEIGHING OIL

The pump room contains the control of the piping systems for oil, compressed air and steam. The oil scales are close by at the right. Outside the wall behind the scale beams are scale platforms on which are permanently mounted the measuring tanks. Oil passes through these tanks en route to and from the retorts.

Control valves for oil, air and vapor connections are concentrated centrally in the pump room. Adjacent to this is an instrument board carrying indicating and recording instruments as well as automatic temperature controllers. The scales on which the measuring tanks are mounted are also read at this point, so that this becomes the main control center for operating the retorts.

The plant is located on ground which is very slightly above high tide and hence to avoid complication in foundations the working level of the plant was fixed about 4 ft. above track level in the surrounding yard, thus making it possible to provide the necessary foundations and sumps with a minimum excavation. In front of the plant the tracks were also elevated to this working level by the use of timber retaining walls and fill. This elevation of the working tracks provides an unloading dock for timber from flat cars to trams and vice versa.

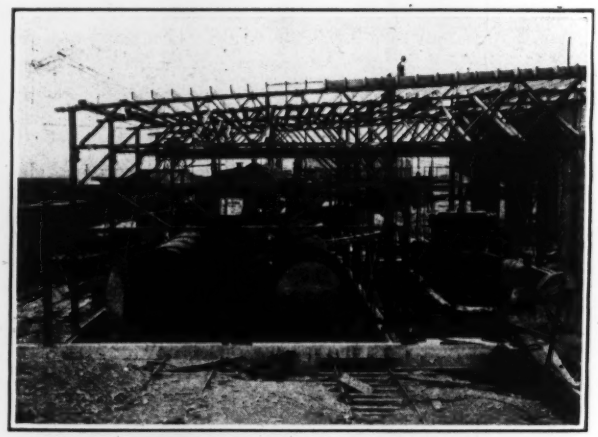
The tie mill, located some 900 ft. from the timber-treating plant, is equipped with standard Greenlee boring, branding and incising machines and has a capacity of 3,000 8-ft. ties per 8-hr. day. A gravity grade from the tie yard leads down to this plant so that a tramload of ties, weighing about 5 tons, can be taken by one man down into the mill where overhead equipment dumps the ties onto the concrete platform from which the mill elevator picks them up, one at a time, and passes them into the automatic machines. The empty trams meantime pass over a semi-circular track around the north end of the plant, still on a gravity grade, to a position convenient for loading ties ready to go to the treating plant.

Special switch ties which range up to 16 ft. in length do not go through the same routing in the tie mill as do the standard 8-ft. ties. The switch ties are not bored and hence do not need to be routed through the boring mill; they are routed as indicated on the tie-mill plan. From the tie mill loaded trams are taken back to the retort by an 8-ton gasoline locomotive usually in trains of 16 trams each, this train constituting a charge for the retort, totaling about 1,000 8-ft. ties.

Experiments with creosoted ties on this system date back more than 20 years and in some divisions creosoted ties have been extensively used. Untreated ties are expected to have a life in service of six to seven years. The same ties when given a treatment costing about $10 per 1,000 ft.b.m. will have an average life of 20 to 25 years. Since the custom on this system is to use rock, gravel or slag ballast exclusively, soil conditions do not enter to any considerable degree into the question of tie life.

Ties are branded, bored for spikes and incised before treatment. The brands which are put on both ends of the tie by automatic pneumatic hammer indicate the year and kind of treatment. One end is indicated for "line end" by the letters LE and this end is used for alignment, any irregularity in the tie length being taken up on the opposite end where ties are laid in trackwork.

Boring is done before treatment because the bored hole provides much better backing for the spike against side pressure and also insures proper treatment of the



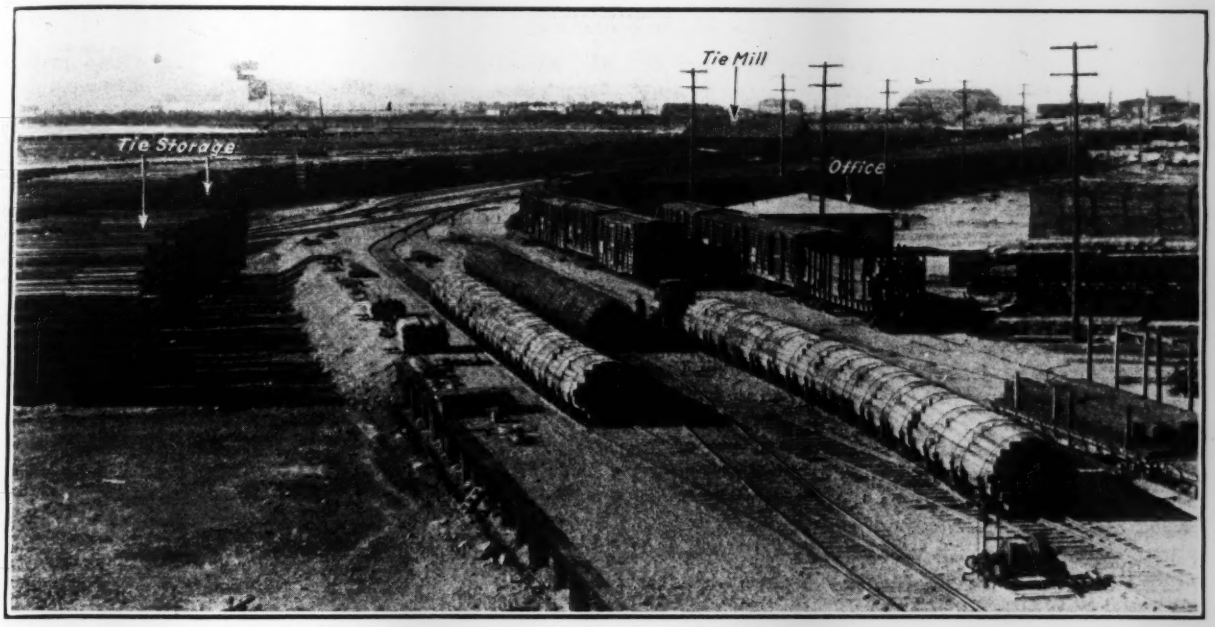
END VIEW OF RETORTS DURING CONSTRUCTION

Note steam heating coils below floor. Rueping cylinder above supplies both retorts.

area around the spike. Unless a tie is bored before treatment, it is pointed out, the spike opens up a means of entry through which water or other causes of decay reach the untreated heart of the tie. The holes are bored $\frac{7}{8}$ in. in diameter and square $\frac{9}{16}$-in. spikes are used. Spikes and tie-plates are the same as are used for untreated ties. The incising, done with a standard incision machine, is designed to permit deeper penetration and thus a more effective preservation of the timber.

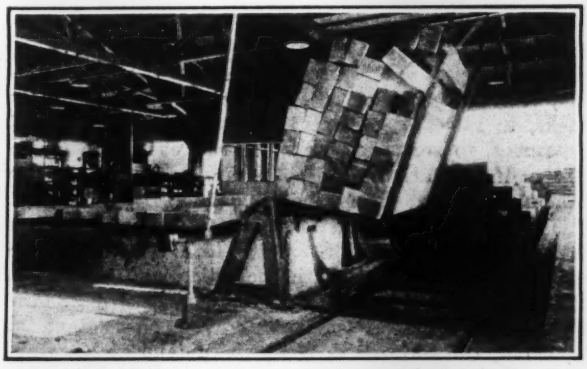
The use of creosoted ties on this company's system has emphasized the care in handling to which all ties are entitled and only standard tie tongs are now used for either treated or untreated ties. The one difference in handling is that the creosoted ties are piled as tightly as possible and covered with earth to prevent loss of the creosote while the untreated ties are piled with spaces between to facilitate circulation of air. Both treated and untreated ties are marked with a dating nail when put into the track.

The entire creosoting plant project was handled by the regular forces of the maintenance-of-way department of the Southern Pacific Co. The plant was designed, built and is operated under the direction of W. H. Kirkbride, engineer, maintenance-of-way and structures, and W. M. Jaekel, assistant engineer, maintenance-of-way and structures.



TRAM-LOADS OF TIES IN TRAINS READY FOR RETORT

View from roof of treating plant. Train in center has just come out of treating plant. Two trains are ready to go in. Note timber bulkhead in center foreground retaining fill. Winch in right foreground starts trains out of retort after which an 8-ton gasoline locomotive does all spotting of trains on tracks.



TRAM LOAD OF TIES DELIVERING TO TIE MILL

Note hinged arms pulled up by chains from overhead pulley that unloads the trains. The arms fit down below track level in grooves. Branding, boring and incising mills in background.

Dry Rot Endangers High School Roof Truss

An instructive case of dry rot damage is described in the report of the state chief engineer of Wisconsin for the fourth quarter of 1925. During a routine inspection of the high school at Elkhorn recently, while the timber construction and roof support of the building was being examined, the inspector discovered serious dry rot in a large roof truss. The end of the bottom chord and diagonal end post had been buried in substantial masonry, preventing ventilation and permitting the development of dry rot. The entire cross-section of the bottom chord was completely decayed, causing all the roof load to be transmitted diagonally through the end pasts to the masonry piers and walls. This produced a dangerous outward pressure on the wall. The condition possibly had existed for some years, and might have continued longer, until some disturbance of the structure caused a failure of the wall and collapse. As it is, the condition will be remedied by replacing the timbers. The report concludes that "The condition found indicates the need of careful examination of those portions of structures which are subject to deterioration through any agency to which they may be exposed."

Chicago Terminal Electrification on the Illinois Central

Suburban Service to Begin in July—Main-Line Service Later—Terminal and Lake Front Improvements, Passenger Stations and Freight Yard—Overhead Wire System—Suburban Train Equipment

By D. J. Brumley
Chief Engineer, Chicago Terminal Improvement
Illinois Central R.R.

THE HISTORY of the Illinois Central R.R. and its Chicago terminals is interlocked with the history of the state of Illinois and the city of Chicago. In 1851, the state gave a charter and land grants to the Illinois Central Railroad Co. on condition that it would build a 705-mile line from Centralia to Chicago within six years, and in 1852 the lake shore location was adopted by city ordinance. Since that time the lake front has increased in importance as a city park, an increase which finally resulted, in 1919, in an agreement between the city, the railroad and the South Park Commission under which the railroad undertook the following projects: (1) Reconstruction of passenger, freight and suburban terminals; (2) rearrangement of suburban facilities throughout the suburban zone; (3) construction of additional tracks; (4) relocation of the eastern end of the St. Charles Air Line to permit the desired development at the main passenger terminal; (5) construction of an elevated railroad, with all grades separated, to connect the main line to the south with that to the west, thus making it possible for other railroads to reach the harbor district or to enter the Lake Front terminal station; (6) lowering the grade between 29th and 43rd Sts., to permit construction of viaducts to the park lands on the east, and raising the grade between 43rd and 51st Sts., to permit building of subways; (7) introduction of electric traction.

Under the terms of the agreement the company was to put electric operation into effect as follows: The entire suburban service by Feb. 20, 1927; freight service north and south of Roosevelt Road by Feb. 20, 1930 and 1935 respectively; all through passenger service by Feb. 20, 1940, providing that a given percentage of the railroads using the Lake Front passenger terminal are operating electrically at that time. Figs. 2 and 3 show the overhead wiring and supports installed on the suburban tracks. Fig. 1 is a map of the terminal lines. The main passenger station is at Roosevelt Road, while the suburban terminal is farther north, between Randolph St. and the river.

Suburban Project—The Illinois Central R.R. suburban and local freight terminals at Randolph St. and Michigan Ave. cover an area of 65 acres, the upper level of which is adapted for commercial development, with the suburban service and local freight business cared for at the lower level. Release of this area for early air-right development is provided by the present plans. The suburban terminal will be constructed with eight station tracks, each of sufficient length to accommodate a train of ten of the new standard cars. Along the main line, the suburban trains will operate on tracks assigned exclusively to that service, so as to avoid all interference with through passenger and freight trains or switching service. There will be four main tracks from Randolph St. to Roosevelt Road, six to 53rd St., four to Kensington and two to Matteson, the south end of the electrified zone. The South Chicago R.R. and the Kensington & Eastern R.R. will have two main tracks each, while the Blue Island R.R. will have a single main track. These branches will handle both suburban and freight business.

At Roosevelt Road, the suburban tracks will occupy a tunnel below the facilities of the through passenger terminal. South of this terminal the right-of-way has a minimum width of 200 ft. and the plan provides for two industrial tracks on the west side, four suburban tracks, four through passenger and three freight tracks.

Main Passenger Station—This station will be half a block east of Michigan Ave. and will front on the south side of Roosevelt Road, which is 118 ft. wide. Its lands have a frontage of 693 ft. and an average width of 640 ft., with an area of 102 acres extending from 8th St. to 31st St., about 2⅞ miles. The station and office building, opposite the south end of Grant Park, will harmonize in design with adjacent public structures, including the Field Museum, the Shedd Aquarium and the memorial stadium at Soldiers' Field.

Vehicular access to the station will be principally on boulevards reserved for swift moving vehicles, so that traffic to and from the station will not interfere with trucks and slow moving traffic. Access to the baggage, mail and express facilities will be on Indiana Ave., 100 ft. wide, along the west side, which is to be a heavy-traffic route. Being separated from the suburban terminal, the operation of this station will not be affected by growth of the suburban business. Nor will there be any interference from freight and switching service. All railroads entering Chicago from the south and west will have convenient access to the Lake Front station, either by the main line or the 18th St. elevated line.

It is possible to develop a passenger terminal with a total capacity of 80 tracks having a minimum length of 1,200 ft. If the growth of the terminal traffic should demand it, a through-track arrangement can be constructed on the lowest level, with two stub-track levels above it, and with permissible gradients for all levels on the main track approaches.

Preliminary Work—In preparation for the electrification, it was necessary to carry out many changes in tracks, to relocate intermediate stations and overhead structures, to separate grades of railroads, and to secure a final location for the tracks before the bridge supports carrying the electrical conductors are erected. This involves the completion of the Kensington track elevation between 83rd St. and 115th St., and grade separation at crossings with the Chicago Junction Ry. at 43rd St., the South Chicago branch at 67th St., the Rock Island and the Chicago & Western Indiana at Burnside; the Chicago & Western Indiana at Kensington, and the Baltimore & Ohio and the Pennsylvania R.R. at Riverdale. Also track elevation at Harvey, with elimination of grade crossings of the Baltimore & Ohio and the Grand Trunk; and track elevation in Matteson, with elimination of crossings of the Elgin,

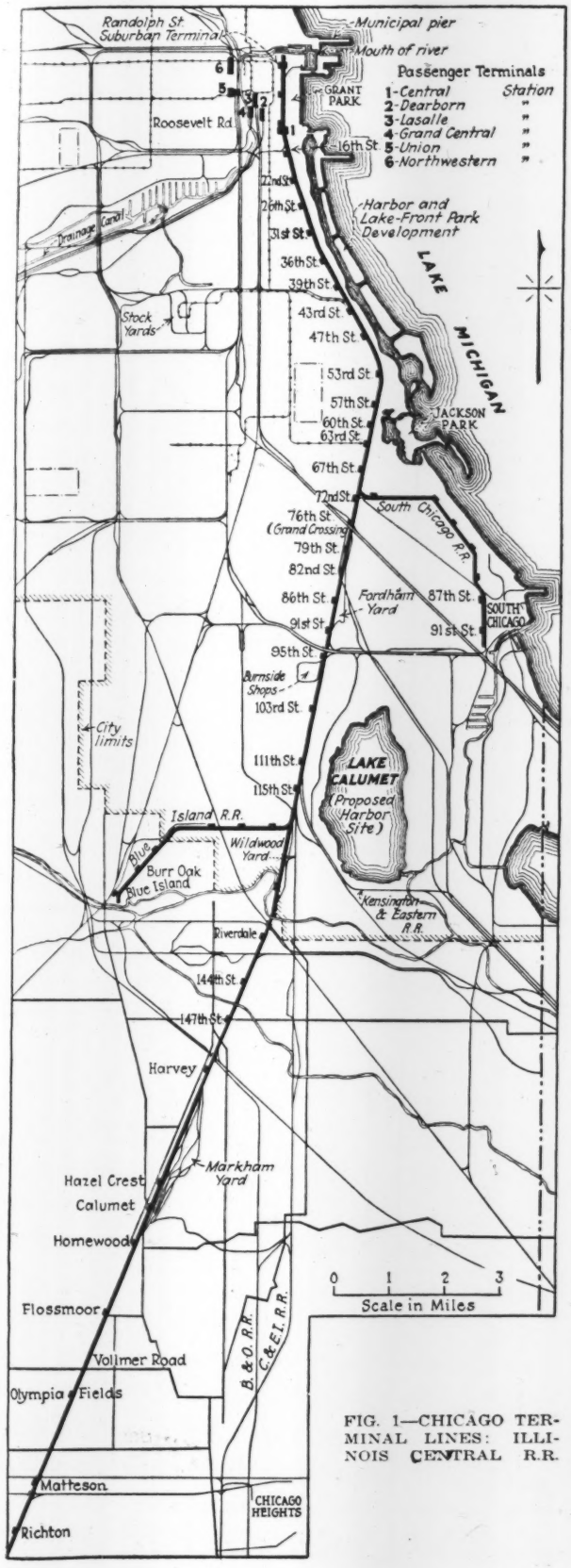


FIG. 1—CHICAGO TERMINAL LINES: ILLINOIS CENTRAL R.R.

Joliet & Eastern Ry. and the Michigan Central R.R.

As it was deemed uneconomical to attempt to continue the operation of the Fordham and Wildwood freight yards, within the city limits, for handling the general classification freight, a large terminal yard, known as the Markham yard, is now under construction at Harvey, 22 miles from the central business district.

Electrification Project—The Illinois Central problems are intimately associated with those of other lines in the city, so that the solving of its own terminal problems necessitated consideration of the interchange with other lines. On account of this electrification being the first attempted in Chicago, and of the effect a decision would have on interchange relations within the terminal area, a commission was appointed to study the operating data of other electrical installations and their adaptability to the conditions of the Chicago terminal area. This commission was composed of A. S. Baldwin, (now deceased), vice-president, Illinois Central R.R.; D. J. Brumley, chief engineer, Chicago Terminal Improvements, I. C. R. R.; Bion J. Arnold, George Gibbs and Cary T. Hutchinson, consulting engineers, and W. M. Vandersluis, engineer-secretary. In view of the time limits for completion of different sections of the work, as noted above, the system sought was one which could be adapted initially to suburban multiple-unit operation and later, by means of locomotives, to handling main-line passenger and freight trains. The electrification involves 125 track miles for suburban service, 185 for freight and 107 for through passenger service, a total of 417 track miles on 36.84 route miles.

Seven systems were considered by the commission: (1) Alternating current, three-phase, with double catenary trolley; (2) storage battery locomotives; (3) Diesel-engine locomotives and other self-contained smokeless units; (4) 750-volt direct-current with third rail; (5-6) 1,500- and 3,000-volt direct-current with overhead catenary trolley; and (7) 11,000-volt alternating-current, single-phase, with overhead catenary trolley. This study resulted in the elimination of all except the 1,500-volt direct-current and the 11,000-volt alternating-current single-phase, each with overhead catenary trolley.

A comparison of these two systems led to the following deductions (1) In power supply, the direct-current system was more favorable on account of the advantages of three-phase power of either 25 or 60 cycles; (2) in power transmission, the three-phase unity power factor system has an advantage over the single-phase low power factor system; (3) for substations, the alternating-current system required only static transformers, but the 1,500-volt system required rotative apparatus in addition; (4) for distribution, with higher voltages the alternating-current system had some advantage in lower initial and operating costs, in appearance on account of lighter structures and lighter feed wire, and in the collection of less current; (5) the direct-current system had the advantage that the train equipments were materially simpler, lighter and cheaper; (6) inductive interference was a consideration in the 11,000-volt system and while it could be mitigated, it involved additional cost of installation and some complication to electric traction installations; (7) electrolytic corrosion can be mitigated or eliminated with less cost than to overcome inductive interference; (8) in safety and reliability both systems were found adequate.

It was evident that the advantages of the 1,500-volt

system were in the power house and motor equipments, while those of the 11,000-volt system were in that part of the installation between the power house and motor unit. On the recommendation of the commission that the 1,500-volt direct-current overhead-contact system was best adapted for the Chicago terminal situation, this system was adopted and is now being installed.

Power Supply—After consideration of the establishment of power stations by the railway and the purchase of power from commercial plants, it was decided to purchase current from the Commonwealth Edison Co. That company will own and operate the substations, and will deliver traction current at 1,500 volts and miscellaneous light and power supply at 4,000 and 2,300 volts. There will be seven traction substations; at 18th, 69th, and 116th Sts.; Harvey, Vollmer Road, Cheltenham and Blue Island (Laflin St.). Additional substations for light and power will be located as and where required. It is estimated that the initial load for suburban operation will require an hourly maximum demand of 22,000 kw. at the substations, and approximately 55,000,000 kw.-hr. per annum.

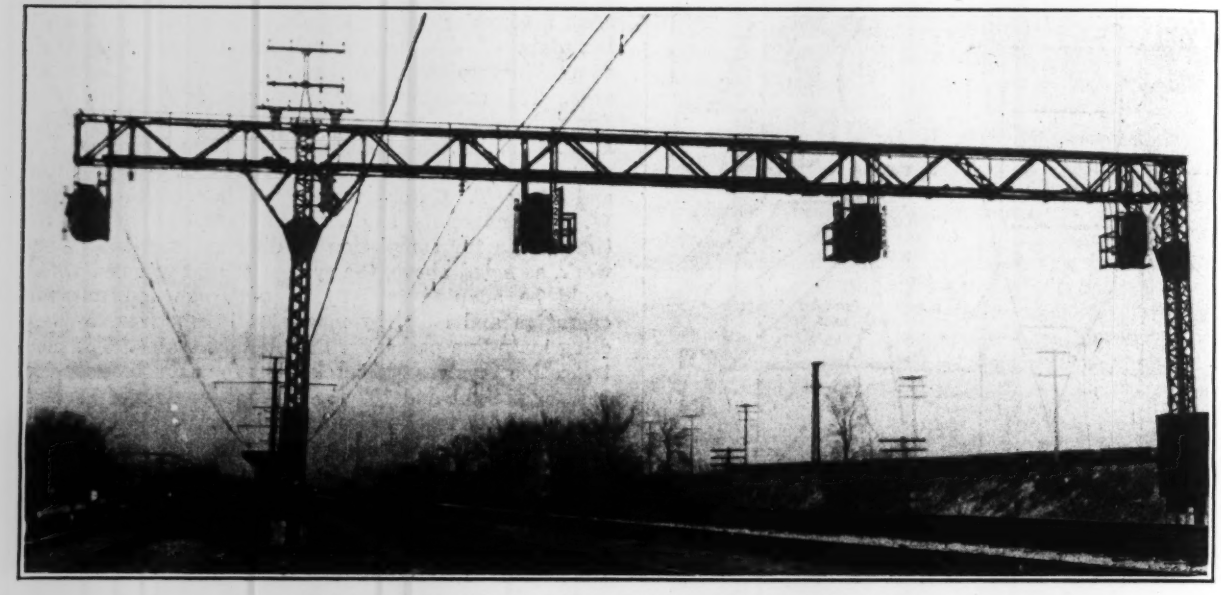


FIG. 2—STEEL BRIDGE FOR CATENARY WIRES AND SIGNALS

Overhead Wire System—Initial electrification for suburban service includes two to six parallel tracks on the main line and one or two tracks on branches, with approximately 110 track miles along 37 miles of route. Ultimately there will be some 417 miles of track, including yards and sidings, and it is necessary to anticipate as many as fifteen main-line tracks in some sections. The catenary system over each track will in itself provide the required current-carrying capacity, without additional feeders. The distribution system will provide for an average voltage drop in normal rush-hour service of approximately 12 per cent, with an all-day average drop estimated at 3 per cent.

Over each main track there will be a composite main messenger of high tensile strength, two bronze or copper grooved contact wires, and a hard-drawn copper lacing cable or auxiliary messenger. In the heavy-traffic section north of 67th St., 3-0 bronze contact wires will be used, in order to obtain the best wearing qualities. On the rest of the main line and on the South Chicago and Blue Island branches, 4-0 copper contact wires will be used. The main messengers will be 0.81 in. in diameter, with 19 strands and an ultimate tensile strength 31,500 lb. Hangers will be spaced 20 ft. apart north of 67th St., and 15 ft. on other points of the line.

Except at a few overhead structures, the normal height of contact wire will be 22 ft. above top of rail at structures, with a 3-in. "hog" or camber to insure against excessive sag under heavy current densities and high temperatures. North of 43rd St., however, the height will be 18½ ft. on account of frequent bridges for access to the park. The minimum height will be 16½ ft. and a gradient of 1 per cent or less with respect to track will be used where the height varies. The auxiliary messenger will be highly flexible, to assure a contact line free from hard spots. It will be hung from the main messenger by hangers spaced at 20- and 15-ft. intervals for the bronze and copper catenary systems respectively. Clips for the contact wires will be spaced at half the interval, with each contact wire supported from alternate clips. The two contact wires of a system will hang side by side, with points of support staggered, but with no appreciable sag.

This relatively elaborate system composed of four wires might be prohibitive for some installations, but for the Illinois Central electrification the total copper would be required in any event for feeder capacity. It thus becomes desirable to provide the electrical conductivity in such a way as to give a mechanical arrangement of great advantage. For the standard 300-ft. span, the main messenger will have a sag of 4 ft. 9 in. under normal conditions. The resulting tension will be 7,700 lb. for normal loading in still air at 60 deg. F., and 12,300 lb. under conditions of maximum loading (zero temperature with ice and wind). Sags will vary with span lengths in such a way as to maintain uniform tension. Chord construction will be used for curves, of which there are relatively few.

The messenger will be supported from the catenary structures by suspension insulators, double insulation being used throughout. The entire catenary system will

thus be below the supporting structure. This allows the use of suspension insulators rather than pin insulators for the heavy catenary system. Further, men may work on structures without danger of contact with live wires, this feature being of added importance in view of the use of the catenary structures for carrying signals (see Fig. 2). Non-ferrous hangers and fittings will be used exclusively, and all connections between the parts of the catenary system will be fixed. For electrical purposes, the component parts are thus so thoroughly cross-connected that they are in effect a single conductor. The minimizing of corrosion of fittings will insure good electrical connections and facilitate maintenance work.

Track and Bonds—All track is of 90-lb. A.R.A. (-A) rail, with a single 4-0 bond on each joint. Additional

FIG. 3—BRACKET POST CONSTRUCTION

return-circuit conductivity will be obtained in the heavy-traffic section between 16th and 69th Sts. by bonding some of the tracks not electrified in the initial stage. Impedance bonds will be installed at the ends of every signal circuit. Tracks will be cross-bonded at alternate impedance bonds, resulting in a spacing of 5,000 to 8,000 ft. for the several classes of service and different portions of the line. Direct-current signals have been in use, but signal track circuits will be changed to alternating-current operation during the process of electrification.

Bridges for Catenaries—The layout and design of catenary supporting structures must provide for their extension for future electrified tracks, although initially they must be applied economically for only suburban tracks. The effect is that structures must be designed at present with the view of serving the entire right-of-way along a large portion of the electrified route. This right-of-way has a minimum width of 200 ft., with portions 250 and 300 ft. wide, exclusive of electrified yards. Individual bents will span up to four or five tracks, with lengths of 60 to 70 ft., but longer bents will be used frequently, with a single span in a few instances for the entire 200-ft. right-of-way.

North of Kensington, on the main line, built-up columns and trusses of latticed-angle construction will be used (Fig. 2). On this part of the line will be the greatest number of electrified tracks, with practically all structures having more than two columns, and with the longest spans. In addition to the heavy catenary loading, certain of these structures will carry signals for various tracks. South of Kensington and on the Blue Island and South Chicago branches, structures will be made up of H-beams for columns and cross-beams. This portion of the main line will have only two electrified tracks initially and single columns with brackets will be used (Fig. 3). Between Kensington and Harvey, about six miles, additional columns and cross-beams will be joined to the initial columns when additional tracks are electrified. On the branch lines, having only one or two tracks, single columns and brackets or two-track portal structures will be used. The structures of rolled sections will not be used for bridges with cross-members continuous for more than one bent. Occasional 3-column structures, required for combined signal and catenary use along the main line south of Kensington, will be of the built-up type.

Cars and Trains—The first twenty suburban cars for use in the electrified service were designed in 1920 and put into service in 1921, before the choice of system of electrification was made. They are of the general size and capacity adopted for electric operation, and weigh 92,000 lb. Shortly after the decision, in 1922, to use 1500-volt direct-current, 25 additional steel suburban cars were purchased, to be used temporarily under steam operation and later under electric operation. These cars were of the same general design, but with changes in their framing and other details to provide for the electrical equipment to be installed later. A reduction in weight of some 6,000 lb. per car was made by the use of an aluminum alloy roof, aluminum doors, and other parts designed specifically to reduce weight. These new cars were also designed to have standard vestibule connections to permit passage between cars without exposure to the weather.

Due to economies of first cost and annual charges, as well as certain operating advantages, two-car motor and trailer units semi-permanently connected, were adopted, with four 750/1,500-volt motors per car. Trains will be made up of from one to five two-car units. Consideration was given to making the unit a fully articulated three-truck unit by the use of one truck common to both cars, but the complications in car framing, connections between cars, wiring and other features made this form less desirable than the additional weight of the extra trailer truck.

Orders have been placed for 130 steel motor cars and 85 trailers, which with the 45 steel cars now in use will make 130 units (260 cars) available for initial electric operation. The motor car and trailer bodies are alike, except that the motor car has the underframe designed for carrying the control apparatus, and the roof for carrying two pantographs. The body is built entirely of copper-bearing steel with inside sheathing of aluminum, roof sheets and lower deck sheets of aluminum alloy, and doors (11 per car) of sheet aluminum. The headlining is ¼-in. fireproof material and the floor of mastic on steel flooring.

Main dimensions and particulars of the cars are: Length over pulling faces of couplers, 72 ft. 2 in.; length over body corners posts, 60 ft. 7 in.; distance between truck centers, 47 ft. 9 in.; width over eaves, 9 ft. 11⅛ in.; width over platforms at vestibule doors, 10 ft. 6 in.; height to top of platform, 4 ft. 3⅝ in.; height to center line of coupler, 2 ft. 10½ in.; height to top of carline,

13 ft. ½ in.; clear opening for body end door and vestibule side door, 4 ft.; vestibule end door, 2 ft. 2 in.; seats, 2 ft. 9½ in. c. to c. Each side will have 17 cross seats, and the seating capacity will be 68 on the cross seats and 16 on longitudinal seats, a total of 84. The weight will be 140,000 lb. for motor cars and 85,000 lb. for trailer cars. High station platforms will be used throughout the suburban zone after electrification.

Motor Equipment—Severe conditions of service warranted thorough investigation of motor requirements on the basis of which specifications could be prepared. These specifications, and all others for electrical equipment, air brakes and other details, were prepared by the electrical engineer's office of the railroad company's Chicago Terminal Improvement organization. It was calculated that a motor of approximately 250 hp. hourly (nominal) rating was required. A gear ratio of 20:57 for 36-in. wheels will be used. Gears will be heat-treated forgings pressed on axles without keys at about 75 tons pressure.

Two pantographs will be installed on each motor car, one over each truck center, with double insulation for the supporting structures. Their normal height will be 22 ft., with an operating range from 16 to 24 ft. above top of rail. They will be spring-raised and air-lowered, and all pantographs in a train may be controlled from any cab. Hook sticks will be provided for lowering by hand in emergency, and pantograph grounding switches will be installed on the car roofs. A complete set of control devices will be installed in each end of the two-car unit, an aluminum door forming a cab for the motorman by sectioning a corner of the platform. This door will normally enclose the control devices and make the entire platform free for passenger use.

Electro-pneumatic brakes operative from either end of any two-car unit are a special feature of the equipment, as this is the first application of electrically-operated brakes on electrified steam railroads, previous use having been confined to metropolitan railways, principally subways. Electric operation of brakes is highly desirable for first-class service, on account of making any desired degree of application or release simultaneously on all cars in the train. Each end of the two-car unit will be equipped with a combined automatic mechanical, air and electric tight-lock coupler, with friction spring draft-gear and ball-and-socket anchorage. The draft gear is designed for a maximum curvature of 33 deg. With the exception of cross-overs and turnouts, the maximum curvature on the electrified main tracks will be approximately 12½ deg. These couplers will be self-centering, and units may be coupled or uncoupled by one man from an adjacent cab, but the couplers may be operated by hand.

Electric heaters will be supplied at 1,500 volts, using five car-body circuits and one cab-heater circuit. This installation was given particular study with the view of reducing the load demand at the time of traction peak loads. Certain elements will be energized normally; for very low temperatures, the remaining elements under cross seats will be energized to provide car temperatures in accordance with the city ordinances. The heaters will be controlled automatically by two thermostats of different temperature settings, subject to selection by trainmen in accordance with operating instructions. The heating may thus be limited for the short haul rush hour service, when cars are crowded, and increased as desired for off-peak and long haul business. This method is expected to effect considerable saving in the cost of energy through the reduction of peak power demands. Thermostats will provide for car temperatures up to 70 deg.

With electrically operated vestibule side doors (four per car), economies in use of compressed air are expected, as well as advantages in operation and maintenance. All doors on one side of a unit may be operated from master control switches, one of which is located at each vestibule corner post of each car, thus making it possible for one man to control the doors of four cars. In addition, each door can be operated independently by a switch located in the same box with the master switch at the adjacent control station. The motorman's compartment is equipped with a switch for providing independent control of the side door in that compartment. Doors will be provided with the most modern features to prevent injury to passengers. A suitable system is provided for operating signal lights in the motorman's cab when all doors are closed, but motor control circuits will not be interlocked with door circuits. An auxiliary buzzer signal system, operative from any platform, is provided.

CHICAGO SUBURBAN TRAIN SCHEDULES: ILLINOIS CENTRAL R.R.

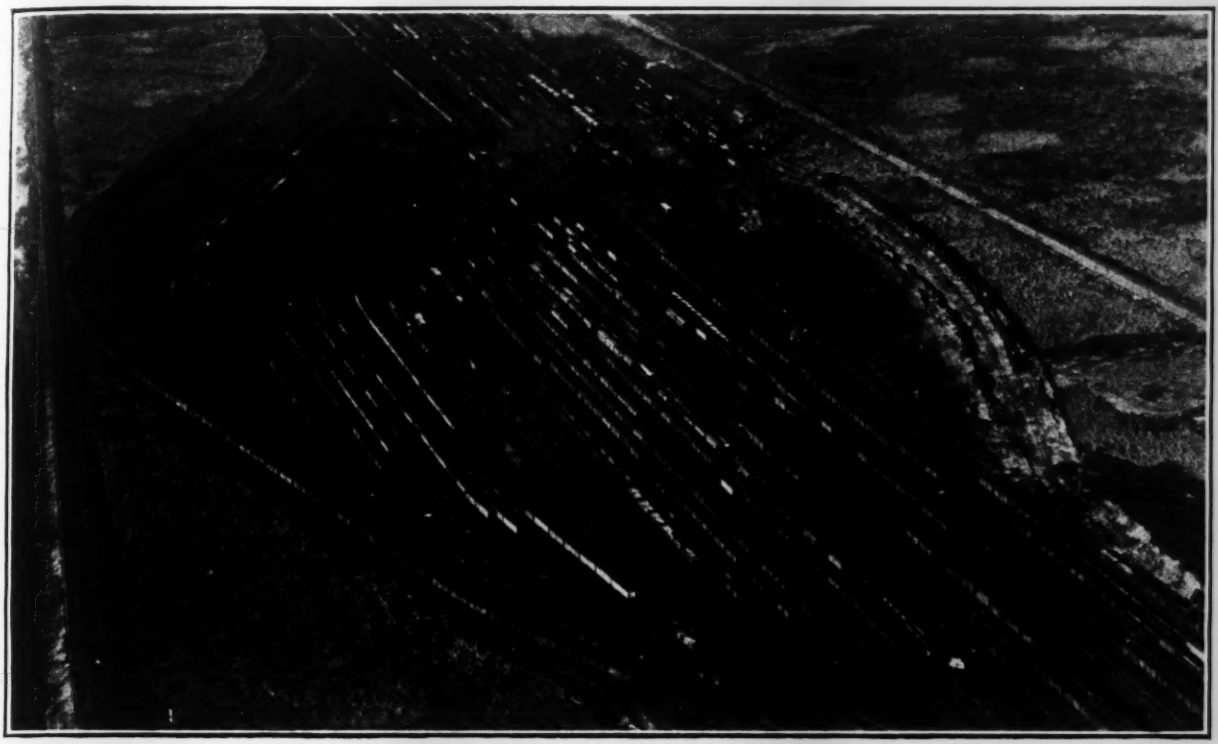
To or from Randolph St.	Length of Trip Miles	Steam Operation No. Intermediate Stops	Steam Operation Schedule Time Minutes	Electric Operation No. intermediate Stops	Electric Operation Schedule Time Minutes	Per cent decrease in schedule time with Electric Operation
67th St.	8.00	..	....	..	....	....
Local	.....	14	30.0	14	24.5	18.3
Express	.....	5	22.0	7	18.0	18.2
Matteson	27.93	..	....	..	....	....
Local	.....	34	85.0	34	71.0	16.5
Express	.....	25	80.0	27	64.0	20.0
Special	.....	13	67.0	13	50.5	24.6
Golf	.....	10	59.0	10	46.5	21.2
So. Chicago	12.47	..	....	..	....	....
Local	.....	22	47.0	22	38.0	19.1
Express	.....	13	38.0	15	31.5	17.1
Special	.....	9	36.0	10	26.5	26.4

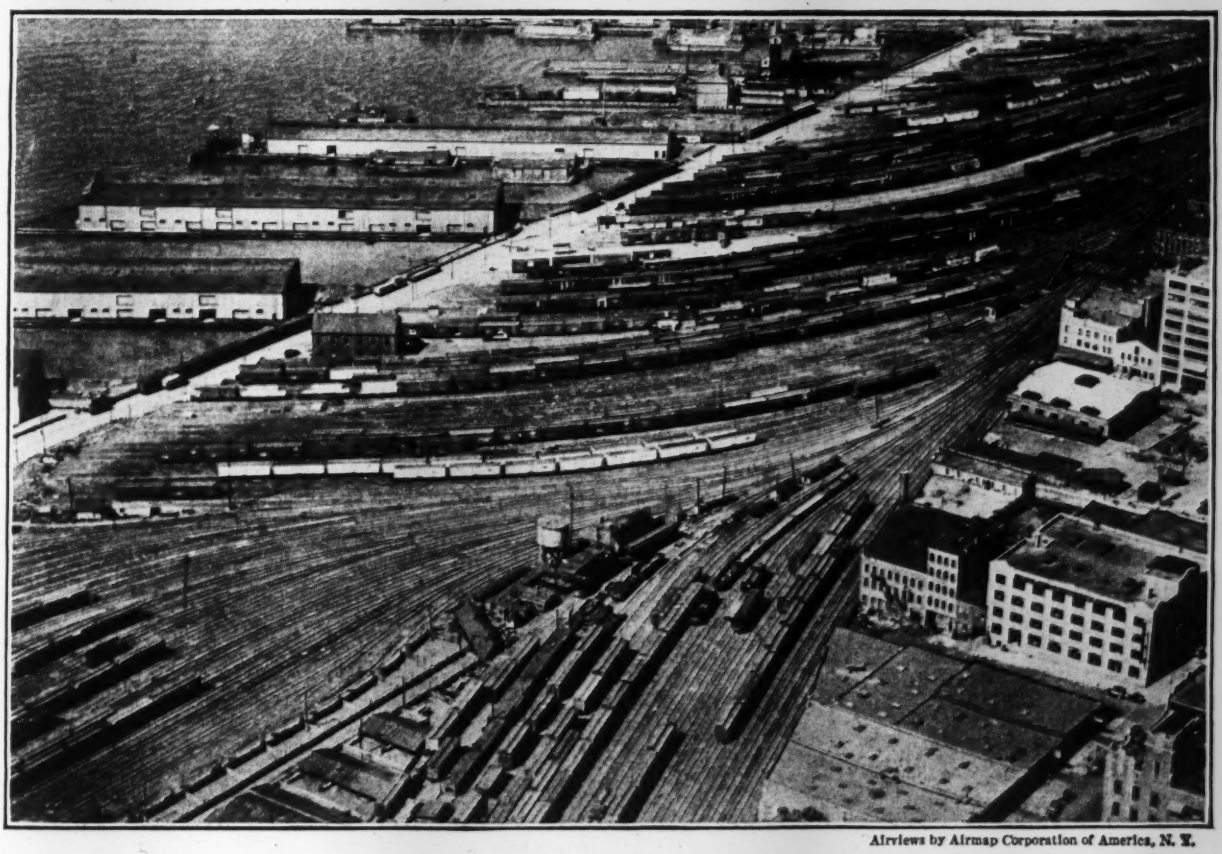
Suburban Train Schedules—A comparison of the present suburban steam service with the proposed electric schedules for 1927 is given in the accompanying table.

Work Accomplished—Extensive and varied work already done includes retaining walls north of Roosevelt Road and south from 29th to 33d St.; raising grade from 43d to 51st St., constructing several sewers and subways and filling Chicago River slips and submerged lands along the shore. Grade separation and track elevation at railway crossings are practically completed at 67th St., Burnside, Riverdale, Harvey and Matteson. The Markham yard was completed sufficiently to permit its initial operation in October, 1925. In all this work there has been extensive rearrangement of tracks and construction of additional tracks. For the catenary supports, concrete foundations have been placed, 80 per cent of the steel structures erected and the overhead conductors placed on the South Chicago branch and on half the distance on the main line. An extraordinary effort is being made to initiate electrical operation on July 1, 1926.

All this work is in charge of a special department known as the Chicago Terminal Improvement organization, under F. L. Thompson, vice-president; with D. J. Brumley, chief engineer; W. G. Arn, assistant chief engineer; W. M. Vandersluis, electrical engineer; and C. H. Mottier, engineer of design.

Two of Many Freight Yards at the Port of New York





Airviews by Airmap Corporation of America, N. Y.

DIFFERENT TYPES OF FREIGHT YARDS AT THE PORT OF NEW YORK

Above: Croxton Yard, Erie R.R. on the New Jersey Meadows. Below: New York Central R.R. Yard on the west side of Manhattan Island at 60th Street

Longest Ballasted-Deck Plate-Girder Bridge; E., J. & E. Ry.

Girders 126 ft. 10 in. Long—One End Supports Adjacent Span—Bridge with Track Complete Erected on Carriages and Rolled Into Place—Cranes Remove Old Truss Span

THE LONGEST plate-girder railway bridge with ballasted deck is believed to be the new 125-ft. span of the Elgin, Joliet & Eastern Ry., across the Des Plaines River near Joliet, Ill. The total length of the girders is 126 ft. 10 in., with bearings 124 ft. 10 in. c. to c. To provide for the difference in depth of the new girders and the old trusses, as well as the greater depth from rail to girder, it was necessary to cut away the top of the pier at one end of the span and to build up the bridge seat on the north abutment, which seat had carried the old deck truss span. These parts of the substructure were then finished with new concrete, as shown. The bridge has one 80-ft. span adjacent to the main span, but this has four girders and is substantial enough to carry the extra load when the solid deck is extended over this span. The bridge was erected at one side of the old span and then rolled into place, as described later. Figs. 1 and 2 show the erection and placing of the bridge; Fig. 3 shows the general design.

Description of Bridge — In the 125-ft. span, two girders 11 ft. 4½ in. deep are spaced 8 ft. 4 in. c. to c. and are connected at intervals of 8 ft. 10¾ in. by cross-frames, with top and bottom diagonal lateral bracing. At the north end, on the abutment, is the expansion bearing, with rockers or segmental rollers. At the opposite end is the fixed bearing with shoes on the pier, and a special support for the adjacent 80-ft. span. Each girder has a ⅝-in. web plate 136 in. deep, made up in three lengths, with four flange angles, while each flange has four cover plates 23x1 in., in lengths of 76 ft. 4 in., 84 ft. 6½ in., 95 ft. and 126 ft. 10 in. The web stiffeners, with a minimum spacing of 40½ in. at the ends of the span and a maximum of 5 ft. 11 in. at the middle, are pairs of angles; these are crimped over the chord angles, except at the cross-frames. For the end stiffeners, there are four angles and two bars. Each cross-frame has struts composed of pairs of angles, with single angles for the diagonals, but the end frames are heavier and have double-angle diagonals. The top diagonals are pairs of angles, while single angles are used for the bottom diagonals. All riveted work is sub-punched and reamed, with 1-in. rivets throughout, except that ⅞-in. rivets are used in the laterals.

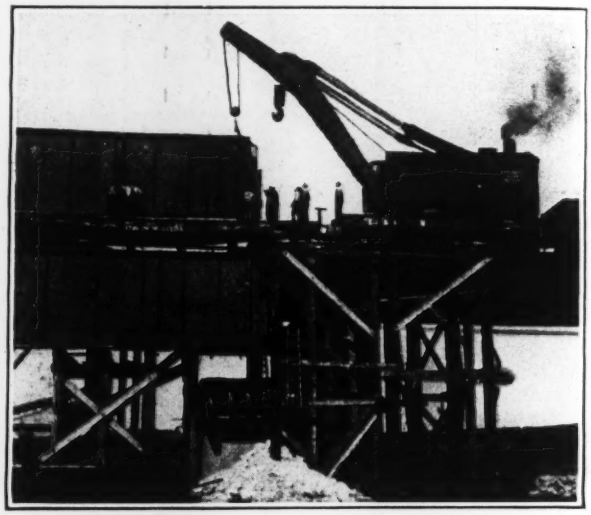


FIG. 1—UNLOADING GIRDERS FOR 125-FT. SPAN
The lower girder is already landed on the timber frame of the carriage. Bottom of old truss span appears beyond. Crane is standing on 80-ft. span.

Two special features are the brackets for the sidewalk and the end cross-girder supporting the adjacent 80-ft. span. For the latter, extension plates riveted to the two 125-ft. girder webs have framed between them, and across the back of the span, a heavy plate girder having seats for the four 80-ft. girders, as shown by

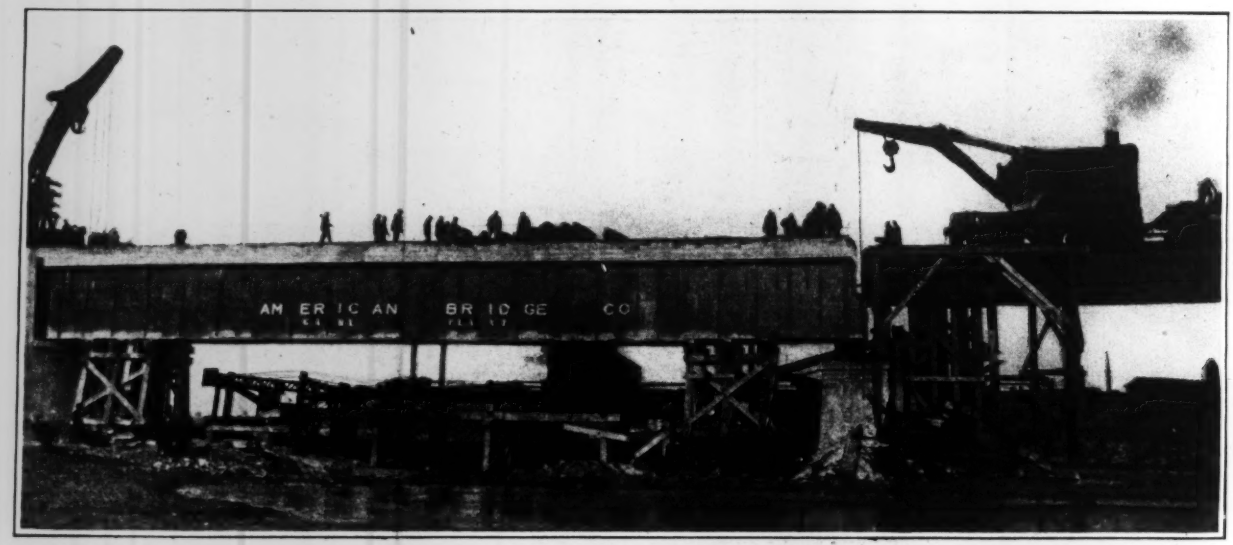


FIG. 2—ROLLING NEW 125-FT. SPAN INTO PLACE
The bridge with concrete deck and track complete is being rolled on carriages supporting the two framed towers.

Fig. 4. In this arrangement, provision is made for lowering the 80-ft. girders so that their top flanges will be level with those of the 125-ft. span. This change will be necessary whenever it is decided to extend the solid deck across the shorter span. For the sidewalk or gangway, the original plan was to bolt triangular brackets to the face of the concrete deck. In construction, however, deeper brackets were used and riveted to the girders, without attachments to the concrete.

Concrete Floor Slab—The concrete deck, which is monolithic, has a width of 12 ft. 4 in. over all and a minimum thickness of 16 in. over the cover plates of the girders, but the concrete extends below the cover plates so that the slab is anchored in position laterally. With the curb walls to retain the ballast the maximum depth of concrete is 37½ in. The curbs extend across the deck to retain the ballast at the ends of the span, and each cross wall has a recess to receive a track tie. The surface of the slab is crowned slightly, and drainage holes are provided on each side at intervals. These drain pipes, which are 5-ft. lengths of cast-iron soil pipe, are set at an angle away from the girders, so that water dripping from them falls clear of the steel.

Construction Work—The new steel span consists of deck plate girders 128 ft. 4½ in. long out to out of steel on the bottom flange angles, and in height 11 ft. 4 in. back to back of angles, while the span to be replaced was a deck truss span 125 ft. 1½ in. c. to c. of end pins and 22 ft. 6 in. deep between centers of chord pins. The bottom chord in the east panel of the truss bridge was inclined up to a bearing on the masonry pier, the top of which was 8 ft. 6 in. below the base of rail and also supported the bearing of the 80-ft. deck plate girder adjacent to the truss span.

As the distance from base of rail to masonry for the new girder span with concrete ballasted floor and shoes is 17 ft., the first move was to cut down the pier under the east end of the old truss span and the west end of old 80-ft. girder span, from 8½ ft. to 17 ft. below base of rail. This was accomplished by cutting around the shoes of both spans to a depth of 24 in. below the shoes, after which the masonry was cut out from under each shoe and replaced with wooden blocking to support the ends of the two spans and carry the traffic as the work progressed.

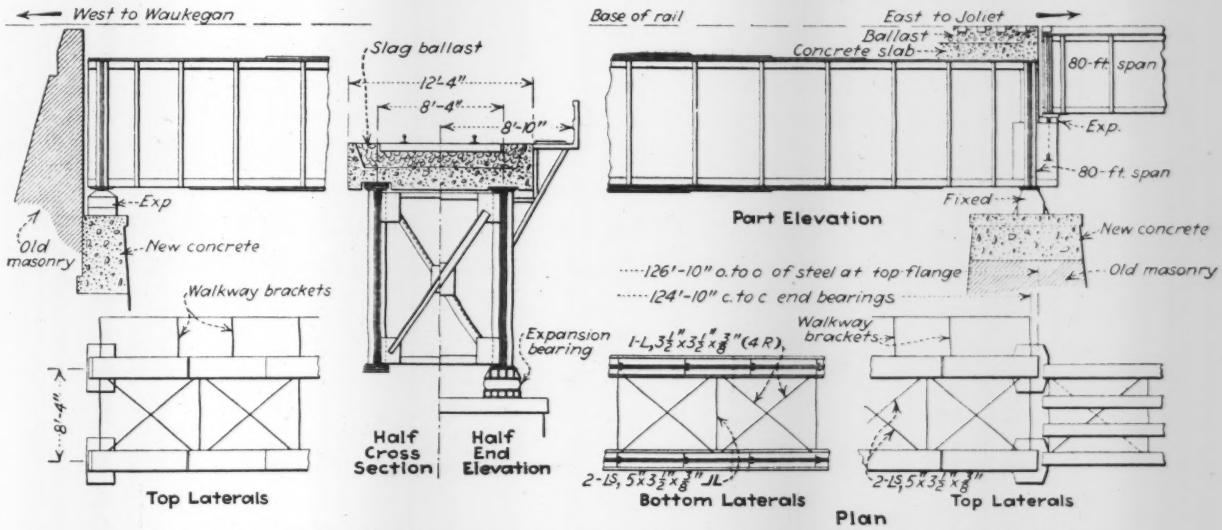


FIG. 3—BALLASTED-DECK GIRDER BRIDGE OF 125-FT. SPAN; ELGIN, JOLIET & EASTERN RY.

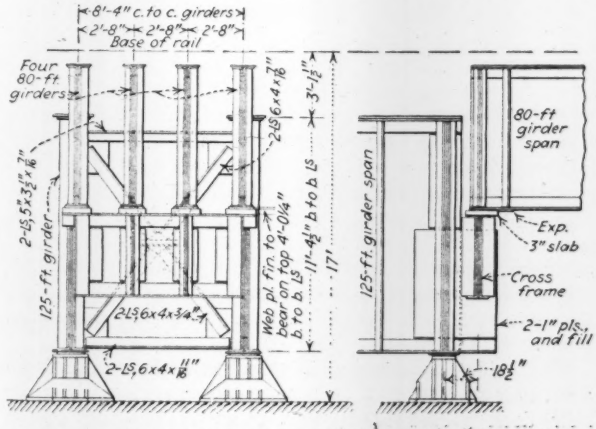
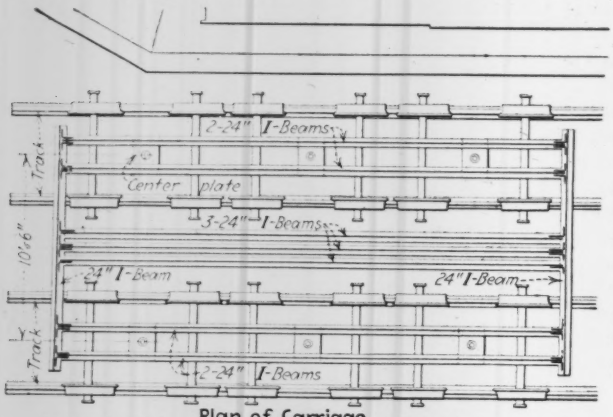


FIG. 4—END FRAME SUPPORTING ADJACENT SPAN

After this blocking was in place, framed bents were constructed under the west end of the 80-ft. span and also on the west side of the pier and around the bottom chord members of the 125-ft. truss span, for supporting the west end of the girders and the east end of the truss span by removing the wooden blocking under the shoes and installing 24-in. I-beams between bents on each side of the pier and over its top. After these I-beams were installed, the work of cutting down the pier was continued to 21 ft. below base of rail, at which point the masonry proved to be in very good condition. A new concrete cap was then built on top of the pier, carrying it up to 17 ft. below base of rail for the new girder span, as shown in Fig. 3.

Traveling Falsework—Under each end of the span were built two standard-gage tracks 10 ft. 6 in. c. to c. and approximately 50 ft. long, having a grade of ½ in. in 50 ft. in the direction which the new span was to be moved. Upon these tracks were erected the two rolling carriages to support the new span, as shown in Fig. 5. On each pair of tracks were placed six trucks from 70-ton freight cars, with a 70-ton body center plate on each pair of trucks. On these center plates was assembled a steel framework 28 ft. long and 12 ft. 2 in wide, consisting of two 24-in. I-beams 28 ft. long, run-

ning lengthwise on the center plates on each set of three trucks, and three similar I-beams 28 ft. long running lengthwise between the end connecting beams and along the center line between the tracks; at each end was a 24-in. I-beam, 12 ft. 2 in. long, to which the seven 28-ft. I-beams were bolted by means of connection angles. The I-beams in this entire frame were fastened together longitudinally by cover plates bolted to the top flanges.

Plan of Carriage

received loaded on flat cars, which were run out onto the old truss span, with a wrecking crane at each end of the cars for lifting the girders off and setting them on the carriages erected on the south side of the old bridge. In order to provide supports for outriggers on the wrecking crane, which was working from the west end of the old 80-ft. span, it was necessary to build falsework up from the ground. The girders were thus unloaded on the carriages, and riveted together complete.

After the riveting, the concrete floor was constructed as a monolithic unit on top of the girders. Its floor thickness was 19 in. in the center, with a slope to 18 in. along the sides, at the parapet walls or curbs. Cast-iron drain pipes were installed 4 ft. c. to c. along each side of the floor at low spots. The parapet walls were carried up to the level of base of rail. This concrete floor was then waterproofed with a three-ply membrane coating, covered and protected by a 1½-in. mastic coating extending up the sides and over the tops of the parapet walls. Slag ballast was placed and track was laid complete on the bridge, with rails cut and fitted so that they would connect up with the existing rails in the main track.

Moving the Span Into Place—With the bridge ready

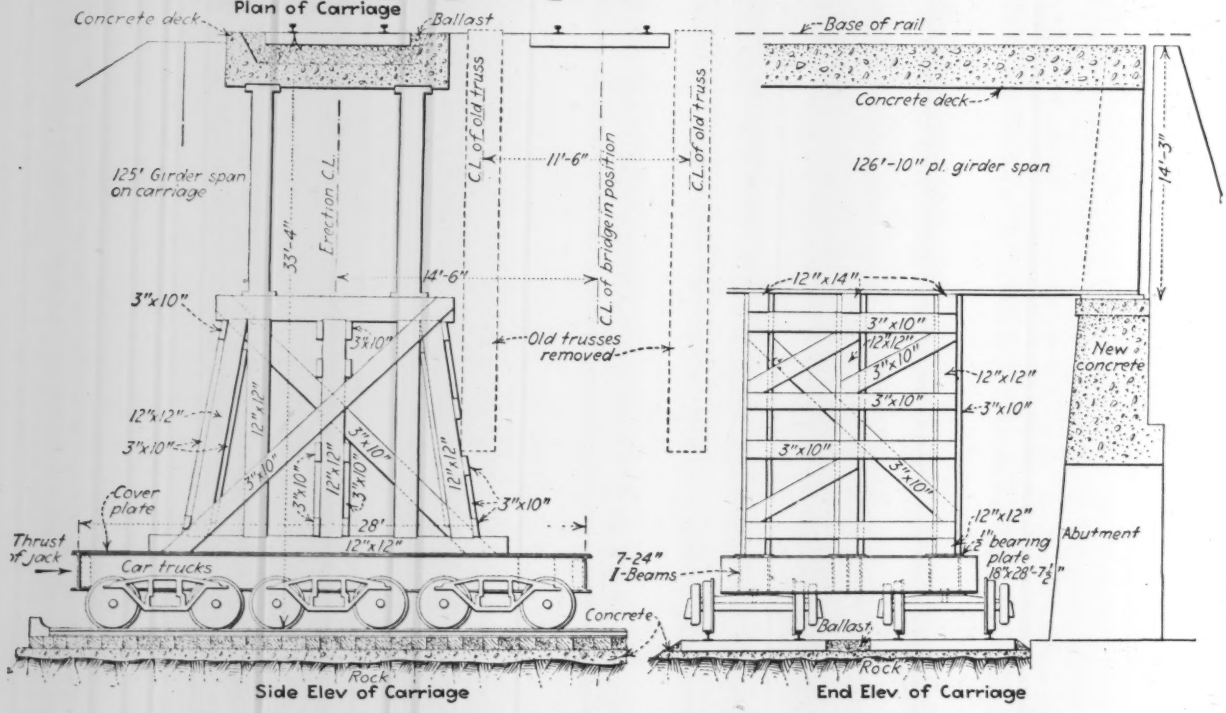


FIG. 5—CARRIAGES ON WHICH BRIDGE WAS ERECTED AND ROLLED INTO PLACE

On each of these carriages three frame bents were constructed, each resting on the longitudinal I-beams, with the top caps of the bents about 2 in. lower than the bottom flanges of the new girders in their final position. This was done so that a pair of shims could be placed on the top of each cap and under each girder when the new girders were set up on the carriages south of the old truss span. The idea of using double shims on each cap was to make it necessary to lift the span only enough to release the bottom shim under each girder, after the removal of which the top shim would drop loose from the rivet heads which were buried in it.

The girders, each of which weighed 72 tons, were to put in place, the two wrecking outfits were again taken to the work and after the rails and deck were removed from the old span, that span was lifted and moved as far to the north as possible by the wrecking cranes, where it was set on the ground to clear the masonry. Hitches were then made on the bottom chord of the old span by the wrecking crane at each end, and the span was upset to the north so that it would clear the carriages which were to carry the new span into place.

The bridge seat under the west end of the old truss span being about 7 ft. 3 in. lower than required for the new deck girder span, two concrete bearing blocks

37x64 in. and 7 ft. 3 in. deep were set on the old bridge seat to provide bearing for the shoes on the new girder span, these blocks being reinforced with rods protruding in all directions to bind in with the concrete which was to be poured around them and carry the old bridge seat up to the elevation of the new bridge when the latter was in place.

The new bridge on the carriages, weighing about 520 tons, was moved in place by inserting two 15-ton stone jacks behind each carriage at about 45 deg., the top or jacking end of the stone jack being against the end I-beam of the carriage and the bottom being against a track tie suitably braced and anchored. No difficulty was experienced in moving the bridge in this manner, as it was found that one jack could move each carriage after the load was started. By using jacks alternately, moving one up at a time, it was possible to keep the bridge in constant motion after it was once started. The actual time required to move it from the erection position at the south of the old bridge to its final position was about thirty minutes. Each carriage with its timber bents weighed about 19 tons, or 38 tons in all. With the 520-ton span the total load was 558 tons or 46.5 tons for each truck, while the trucks were rated at 48 tons capacity.

When in its final position, the span was raised by jacks on the carriage so as to release and remove the shims, after which the span was lowered into place on the shoes, which had been placed before the moving was started. When in place on the shoes, the span cleared the carriage bents by about 1 in., thus leaving the carriages free to be removed. After the new bridge was in service, the old truss span was cut to pieces and loaded for scrap. The new bridge was given a shop coat of paint by the manufacturers and will be given two field coats of paint by the railroad company.

Engineers and Contractors—This bridge is designed for Cooper's E-70 loading and is built to the A.R.E.A. specifications, allowing 50 per cent of live-load for impact. Its dead-load per foot of span is taken as 2,600 lb. for steel, 3,340 lb. for the concrete deck, and 1,885 lb. for the slag ballast and track. Lateral forces are taken as 405 lb. per foot of span for wind pressure on structure, 300 lb. for wind pressure on train and 400 lb. for horizontal impact. From the general layout prepared by the railroad, the design and shop plans were made by the American Bridge Co., which had the contract for fabrication of the steelwork. The bridge was erected by the bridge and building department of the railroad. Both design and construction were under the direction of Arthur Montzheimer, chief engineer of the Elgin, Joliet & Eastern Ry.

Philippine Railway Shows Gain

An index of the economic condition of the Philippine Islands is the income account of the Manila Railroad Co. The stock of this road is owned by the Philippine government. The net income for the first nine months of 1925 was $1,086,000 or almost double that for the corresponding period in 1924, which was $544,000. Operating revenues and expenses for the nine months' periods in the two years were: revenues, first nine months 1925, $4,823,000; 1924, $4,325,000; expenses, same period 1925, $2,782,000, 1924, $2,744,000. The investment of the Philippine government in the capital stock of the road amounts to $11,064,000. The number of miles operated during 1925 was 659.

Concrete Arch Dam with Central Spillway Built on Klamath Project

GERBER dam, a concrete dam of pure arch type, 75 ft. high from foundation to crest of spillway, was completed last June by the U. S. Bureau of Reclamation to supply supplementary storage for the Klamath project in southern Oregon. Its design and construction are described by A. L. Darr, resident engineer, in the *New Reclamation Era* of December, 1925.

The dam impounds water from a drainage area of 200 sq.mi., subject to an annual rainfall of 13 in. It is 478 ft. long on top, and is built to a radius of upstream face ranging from 155 to 197 ft. At the center its downstream face is vertical, while the upstream face is inclined 1:5½. The thickness ranges from 15 ft. at the stream bed to 5 ft. just below spillway crest. The central part of the dam, for a length of 150 ft., is shaped as an overfall dam to serve as spillway; in this portion the crest is rounded and extended outward over the downstream face as a nosing which projects 24 in. from the face. At either side of the spillway section the dam is carried up 10 ft. higher, the upper 3½ ft. of this height being formed by a 14-in. parapet wall. The discharge capacity of the spillway is 10,000 sec.-ft. with 7-ft. overflow depth.

Volcanic rock and boulders form the stream bed. Tests indicated that the rock would prove to be thoroughly tight, but in the actual excavation many crevices and seams were found, whose clay fillings disintegrated on exposure. The foundation was therefore carried 18 ft. deep into the rock, and in the end portions of the dam, as extra precaution against passage of water around the dam at the softer layers of lava, it was keyed into the rock in a keyway 2 to 3 ft. square. The foundation was also thoroughly grouted under 100-lb. pressure, through 112 holes drilled 5 ft. apart and generally about 15 feet deep. The grouting was done after the concrete of the dam had been carried up 6 ft.; 200 sacks of cement were used, the largest amount per hole being 17 sacks.

Concrete pouring began in August, 1924, and was completed in December except for a small amount poured the following May. The mixture ranged from 1:2:4 to 1:2½:4½, depending on the available sand; in the base section and at the joints large stones were placed in the mass. Concreting was done in forms built up of 4x8-ft. panels faced with steel sheets, a sufficient number of forms being provided for working in two consecutive lifts. Contraction joints were formed at 50-ft. spacing, and two small closing segments were poured at low temperatures. The concrete totaled 11,880 cu.yd., and the reinforcement used was 62,933 lb.

To provide for future stress measurements on the dam, 17 thermometers were built into the concrete and 11 gage-point stations for reading strains were laid out (9 stations on the downstream face and 2 on top), in addition to points available for instrumental reading of deflections. During the present season water was impounded to a depth of 25 ft. At first there was slight leakage through the concrete, but this stopped within a few weeks. No sign of leakage under the dam or through the subsoil could be detected.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Railroad Bridge of 36-Ft. Clear Span Built of Heavy Precast Units

By M. Hirschthal
Concrete Engineer, D. L. & W. R.R., Hoboken, N. J.

AN EXAMPLE of the extent to which reinforced concrete has been adapted to heavy duty is presented by construction of a bridge recently completed by the Delaware, Lackawanna & Western R.R. on its new connecting line between Kingsland and Harrison, N. J. The bridge is for a crossing under the Greenwood Lake branch of the Erie R.R.

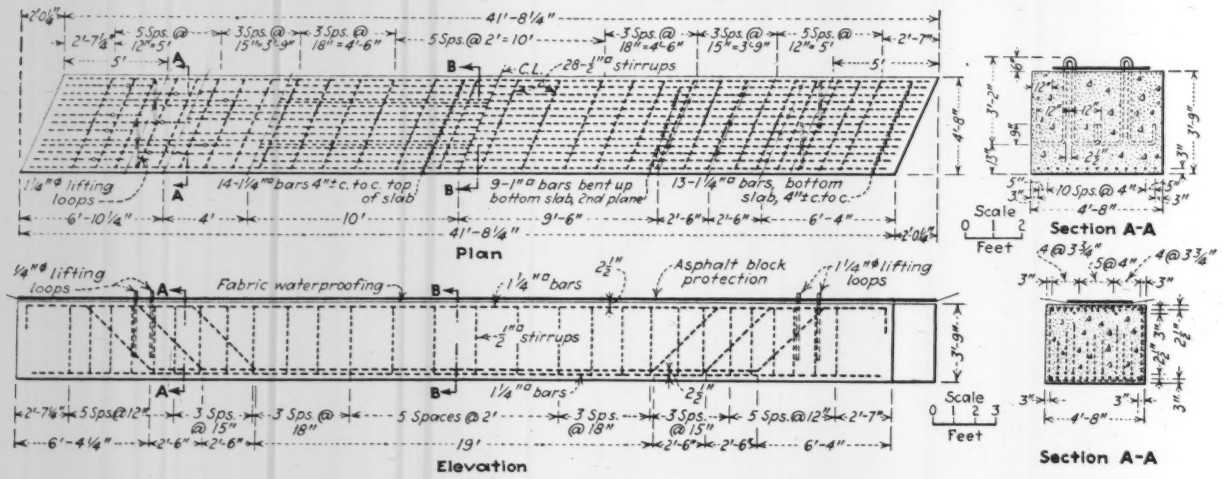
This connecting line crosses the two tracks of the Erie R.R. on a skew of 23 deg. 27 min. 40 sec. In addition, the alignment of both railroads at this crossing is on curves, a 2-deg. curve for the Lackawanna, and a 2½-deg. curve for the Erie, requiring superelevation of tracks and therefore increased clearances, greater span and width of bridge. The clear span measured at right angles to the Lackawanna tracks was made 33 ft. 3 in. for 13-ft. track centers and 3 in. additional clearance on the concave side of the curve to the 10-ft. required from the center line of track. By applying the skew, however, the clear span becomes 36 ft. 3 in. measured along the tangent to the center line of the two Erie tracks.

Inasmuch as it was deemed imperative not to interfere with traffic on the Erie R.R., it was decided to design this bridge for precast reinforced-concrete units poured in a casting yard at Kingsland 2½ miles from the bridge site, and to erect these units after the abutments had been poured and cured. The present units weighed around 50 tons each. It is the belief of the writer that this is the longest span railroad bridge for which precast members have been utilized.

The Erie tracks on either side of this crossing are on 14-ft. track centers permitting a width of three 4-ft. 8-in. precast sections (three being selected rather than two because of the excessive weight of the latter) per track. These slabs were designed for an E-65 engine loading the moments and shears resulting from this loading being figured as distributed over the three sections which support each track. A depth of 3 ft. 9 in. was available for thickness of slab, after allowing for track, ballast and waterproofing. A 4-ft. 10-in. depth would have been required for the design of a simple slab over the 36-ft. 3-in. span, if reinforced for tension and shear only, to make the stresses due to the bending moment of the above engine loading, together with the dead-load and the impact proportioned in accordance with the formula $I = \frac{\text{Live-load}}{\text{Live-load plus dead-load}}$, thus necessitating the use of steel reinforcement in compression to compensate for the deficiency in the concrete section available for compression.

In lieu of the 13 in. of concrete, fourteen 1¼-in. square bars are placed near the top surface of each 4-ft. 8-in. section or unit, making it possible to install this type of structure under the given conditions, and at the same time reducing the weight of these heavy units to about 55 tons, facilitating their erection. The reinforcement for tensile stresses in each 4-ft. 8-in. unit consists of a plane of thirteen 1¼-in. square bars, which are carried straight for the full length of the slab, and 3 in. above these, nine 1-in. square bars which are bent up near the supports to take diagonal tension for which purpose ½-in. square bar stirrups are added, spaced as shown on details in the figure herewith. Two lifting loops of 1¼-in. round rods are embedded near each end to permit the use of a spreader in erection.

The parapet slabs being designed without consideration of the engine loading require no compressive reinforcement, the bars in the upper plane being provided merely to take stresses due to temperature changes. On these parapet units there will be erected a concrete balustrade, the panels of which are precast while the posts between



DETAILS OF 50-ODD-TON PRECAST UNITS FOR LACKAWANNA RAILROAD BRIDGE

them will be poured in place. For this purpose vertical stubs protruding from the parapet at the location of the posts were provided.

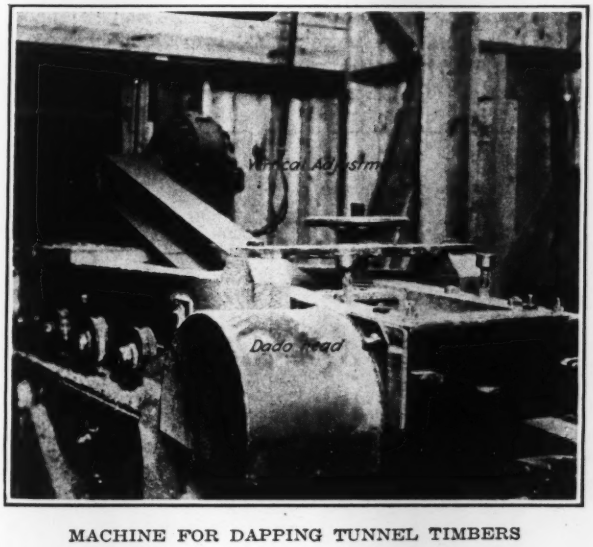
Waterproofing was also installed in the casting yard, leaving only the work at the edges of the slabs to be completed in the field. The waterproofing consists of two layers of asphalt-saturated open mesh cloth, with a protection of 8x4x1¼-in. thick asphalt paving blocks. The waterproofing cloth was bent back near each edge, the blocks being laid up to the point where the cloth was bent back, respectively 1 ft. and 8 in. from the edges of the slab. These slabs, having been allowed to cure and the abutments having in the meanwhile been poured and cured, the former were loaded on flat cars and shipped to the site of the bridge.

Between the operation of Erie trains two cranes, placed on either side of the opening, lifted the slabs off the flat cars and set them in place. One-half of the slabs were set on one day, the other half the following day, after which the waterproofing at the joints of the slab was completed by bending back the fabric and setting the asphalt block over it. Then the bridge was ready for train operation.

G. J. Ray, under whose direction both design and construction of all the structures on the connecting line were completed, is chief engineer of the D., L. & W. R.R., and J. L. Vogel is bridge engineer. The writer assisted in the design, while M. H. Doughty with W. H. Speirs as resident engineer, had supervision of construction work.

Timber Dapping Machine Used on Moffat Tunnel

IN FRAMING tunnel timbers, the cutting of daps by hand becomes an expensive item. Furthermore, getting hand-made cuts uniform imposes a handicap, particularly in the placing of roof segments. To overcome this difficulty and speed up work on the Moffat Tunnel through the Colorado Rockies, where about 9,000,000 ft. b.m. of timber are being placed, an inexpensive dapping machine has been devised which, because of its simplicity, might prove valuable on any mine or timber structure work where quantity of production of uniformly dapped timbers is required; the machine is shown in operation.



MACHINE FOR DAPPING TUNNEL TIMBERS

A dado head consisting of two circular saws or groovers with several inside cutters to make up the required width of cut is mounted on a regular circular saw mandrel, which in turn is attached to a wooden frame that runs on grooved wheels along a track at right angles to the dead rolls carrying the timbers to be dapped. The same frame that carries the dado head, with its vertical screw thread adjustment, also carries the 7½-hp. motor and belt drive. Wires for the motor connection hang from the ceiling.

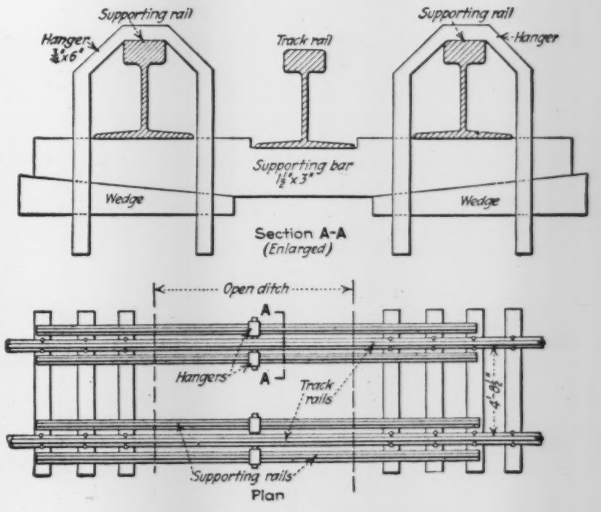
To cut a dap the operator, by a slight pull on the handle attached to the front of the frame, draws the whole unit far enough to cause the saw to cut its way across the timber.

The machine, which was designed by C. A. Betts, office engineer, and built by Hendrie & Bolthoff, Denver, can be built on the job for about $600, including the cost of dado head and motor. It has saved the contractor many times its cost in a few months of steady work.

Device Supports Track Rails Over Open Ditches

By J. H. Sawkins
Dept. Grounds & Bldgs., General Electric Co., Schenectady, N. Y.

THE accompanying sketch shows a practicable way of supporting tracks over an open ditch in which construction of a culvert, pipe line or the like is being done. This affords a means of maintaining traffic over the rails, is safe, easily set up and simply and cheaply made. Let it be understood, however, that this construction is applicable only to short spans for heavy types of locomotives.



DETAILS AND USE OF TRACK SUPPORTING DEVICE

The four supporting rails should preferably be of the same weight as the running rails so as to reduce deflection, and they should extend beyond the limits of the open ditch for about 6 ft. for ordinary cases, but, of course, this depends on the supporting value of the

soil adjacent to the ditch. The notch at the center of the supporting bar provides against spreading of the rails. The wedges should be firmly driven in.

British Track Laying Device Lays Track in Complete Sections

IN ENGLAND where rails are not "staggered" and it is not uncommon practice to replace trackage in its entirety, a track-layer has been perfected which lays track with great speed and a minimum handling of materials. A speed of from 120 to 150 yards per hour has been made where 45-ft. rails are used.

The track is made in sections in a central assembling yard, where it is loaded on flat cars by means of an

FIG. 1—OVERHEAD TROLLEY CARRYING TRACK SECTION TO LAYING MACHINE

overhead crane, six sections to a car. A train-load of these cars, which are equipped with tracks on the outside for an overhead trolley, is taken to the point of operations where the track layer with the trolley stored on the rear end is attached. An electric generating plant installed on a small car at the rear of the train supplies power for operating the equipment.

A section of track is picked up by the train-trolley Fig. 1 and carried to the "layer" Fig. 2, which drops the track at the desired place. If old track is being torn up the ballast is dug out from between the ties in advance of the train and the old track is picked up by the track layer and moved back to its rear where it can be picked up by the trolley after it delivers the new section to the track layer. In this way the old track is all loaded up for return to the assembly yard for salvage. The machine and accessory equipment are manufactured by Herbert Morris, Ltd., Loughborough, England, who claim to have perfected a method of adapting this machine to track on which the rails are staggered as in this country. In this method the rail and ties are assembled in sections as usual but with one rail left loose in the spikes. After the track has been laid the loose rail is pulled into position, six or eight rails at a time. Small four-hole fishplates are used on the loose rail when first laid. The reverse of this operation has been carried out in this country in loading up whole sections of track which had been laid with staggered joints.

One of these track-layers has been used to advantage on the Great Southern Ry. in Ireland, according to *The Engineer*, London. On this road, which has the Irish gage of 5 ft. 3 in., and is laid with 45-ft. 95-lb. T-rails bolted to wood ties, 1,800 ft. of track was relaid in five hours at night, with four working hours. In all, eighty sections of track were handled, forty old and forty new sections.

From Job and Office

Hints that Cut Cost and Time

Push Cars Used Effectively in Track Demolition

BY GARRETT DAVIS
Division Engineer, Retired, Chicago, Rock Island & Pacific Ry.

LAST fall forces of the Chicago, Rock Island & Pacific R.R. pulled up about 16 miles of branch line track without the use of a work train except for two days while picking up cast-iron pipe with a wrecking derrick. The work was done with two heavy push cars of the track-laying type, coupled with rods on bars about 10 ft. long, and two power cars. On the four outer corners of the two push cars, blocks about 6 in. high were secured. On these blocks the first two rails of

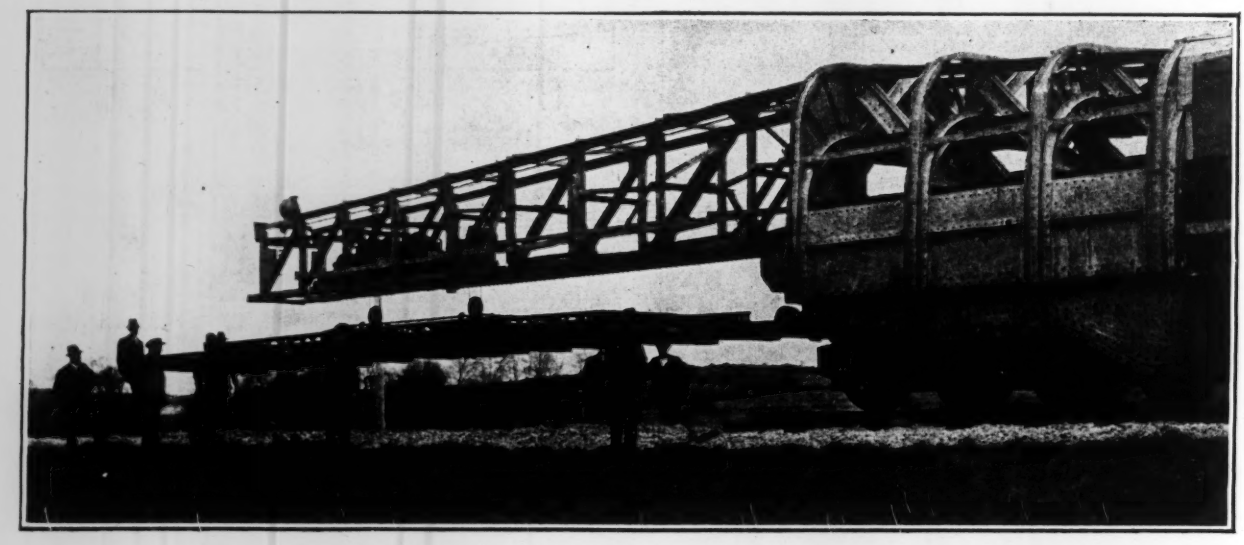


FIG. 2—TRACK LAYER PLACING SECTION OF TRACK

From Job and Office

For Contractor and Engineer

each load were placed, and the good ties in that panel (usually about 7 to 9 or half the total in the panel) were placed on top of the two rails. The rails in the subsequent panels were pushed under the ties, and the ties placed on top until the load was completed. About 24 to 26 rails with the 150 ties made the load. If the ties were running heavy less panels could be pulled up, but 22 to 28 rails with 130 to 150 ties was the load limit.

The bolts were broken off and the scrap with the spikes was picked up in boxes or kegs and piled at the front ends of the rails. The angle bars were piled in the push cars under the rail.

The material was pulled into the station and quickly thrown off by 10 to 14 men who would load it into cars while the motorman returned for another load. The men at the front disconnected the joints, and pulled all the spikes except about two per rail while the load was being taken into the station. All the bridge bolts in timber trestles had been removed ahead of the track forces, and the stringers were loaded and taken in soon as the track was removed. The caps could not be recovered without too much delay to the track force, so a bridge gang and motor truck followed up and recovered the caps and piling where its value justified the expense. Unless the caps and piling are treated material and sound, it is not worth recovering.

From 12 to 16 men at the front are usually enough, but this will be governed by the distance the front is from the loading point. Three push cars and three motor cars are necessary to provide an emergency set in case of break down. On level or down grade there is no trouble to start the load if the track is not weedy but on an ascending up grade it is necessary with nearly full load for the men to assist starting by pushing or it may be necessary to make lighter loads where conditions are adverse. Weeds are a decided deterrent, for if the rail is badly covered with weeds or grass the motor cars are almost helpless.

The cost is about $500 per mile, or ten cents per lineal foot with labor at 38 cents per hour. Some variation from this may be expected, depending on track conditions, grades on the line, the distance between stations, etc.

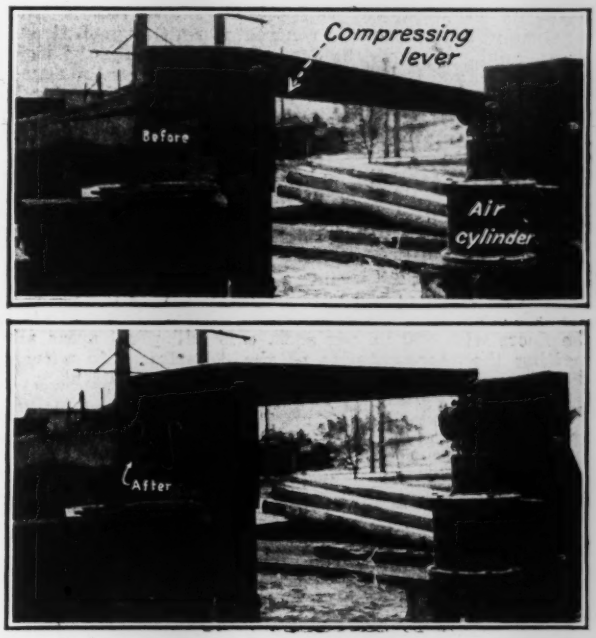
Split Ties Reclaimed by Compressed-Air Machine Made from Scrap

By Andrew Gibson
Superintendent, T. P. & T. T. Plants, Northern Pacific Railway Co.

For pulling badly split ties together so that "S" irons can be applied, a machine operated by compressed air has been devised at the Brainerd, Minn., treating plant of the Northern Pacific Railway Co. For the past few years, a lever and chain have been used for this work, but the operation was too slow and required too many men—three being necessary to do what one man does with the new machine. Birch constitutes 80 per cent of the ties received at the plant and this species of timber has a tendency to split when seasoning, more especially the hewn ties.

The machine as illustrated is built from old material taken from the scrap dock at the Brainerd shops. The frame is made from pieces of old car sills, the lever from an old piece of iron once the side rod of a small locomotive. The cylinder was once used as a brake cylinder and the plates and bolts are pick-ups that were worked over by our engineer and a handy man at the plant. These men worked up the material and assembled the machine at the plant in two days' time.

The machine is operated by air through a ½-in. hose



COMPRESSED AIR MACHINE FOR RECLAIMING SPLIT TIES

that taps the air line to our boring and adzing machine, and is quite convenient to the tie pile. From 20 to 40 lb. of air is required to pull the ties together. One man can operate the machine and apply the "S" irons, but when a hurry-up job is necessary and a considerable supply of split ties is on hand, two men can reclaim about 30 ties per hour. We usually do not have more than 15 to 20 badly split ties a day, so that one man can reclaim all of one day's work in about an hour or an hour and a half.

Job and Office Notes

During the Painting of the Girders of the new bridge of the Central Railroad of New Jersey over Newark Bay, the painters worked from the girders themselves or from scaffolds suspended from them and 40 ft. above the water. As a safety precaution, under each section of the structure where the painters were working there were floating in the water, life preservers attached to lines fastened to the structure. If a man missed his footing and fell into the water, he would have fallen near one of these life preservers and should have been able easily to reach it. The use of these life preservers was a very cheap and effective way of insuring against what might have been a serious accident. —G. H. McKelway, 543 Hillcrest Ave., Westfield, N. J.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Concrete Flat-Slab Strength Increases With Time

Sir—In your issue of Feb. 11, W. H. Wheeler comments on the behavior of a concrete building in St. Paul, originally built for Brown & Bigelow Co., dealers, in paper, etc., now leased for the storage of flour, feed, etc. This building was constructed by a pioneer in concrete work, George J. Grant, of St. Paul. He could be depended upon to use the right kind of sand and washed gravel or hard stone for the aggregate. He could be depended upon to put enough water in the mix so that sound concrete would result without the uncertainties of the honey-comb product of cement water ratios in vogue today.

Mr. Wheeler was called in by the lessee to advise procedure in view of the notification of the St. Paul building department that the floor loads for safety should be limited to 100 or 125 lb. per sq.ft. in this building. At Mr. Wheeler's request, I visited the building; I found the slabs in excellent condition, advised issuing a written statement questioning the accuracy of the building department's objection to the safe capacity of the floors, expressing willingness to test the floors with 800 lb. per sq.ft. over full panel areas and inviting the representative of the department to witness the test and draw conclusions warranted by observation of the elastic strength developed by test.

My recommendation was not carried out in full because of the expense of getting together enough material for an 800-lb. test load, as such material was not available in the warehouse. They, therefore, used the material they were dealing with and filled the space from the floor to the ceiling in making the test.

Had my recommendations been carried out, and for them I was willing to assume the responsibility for any damage to the building, the test load would have been twenty-five times as great as allowed under the slab thicknesses, sixteen times as great as the steel provides for, eleven times as great as the diameter of the column cap provides for under the Joint Committee rules. Further, Mr. Wheeler's tests show complete elastic recovery on removal of the load.

But all who have tested concrete buildings when finished and cured from 60 to 90 days have observed a residual set or permanent deflection resulting from the application of the load, except in those cases where some architect who did not know better has required that there be no deflection and the contractor has fulfilled the specification by soaking the top of the floor after removal of the load so that it comes back to its original alignment.

This change in deportment due to age is readily explained. Internal strain from the shrinkage stresses between the concrete and the metal in curing is eliminated in the concrete by the continued loading and unloading of practical use so that concrete of good quality in time becomes a more perfectly elastic material.

As this flooring was guaranteed for a 500-lb. test load and no more at 90 days after completion, why is it that the writer could guarantee an 800-lb. test load 13 years after completion? There has not been a 60 per cent increment in the comprehensive strength of the concrete during that period and no increase in the tensile resistance of the steel, but there has been during that period a great increase in the shearing rigidity of the concrete. Since plate action depends predominantly on the shearing rigidity of the concrete which increases greatly with age, an ordinary "mushroom" slab designed for 100 lb. per sq.ft. will at the end of 10 years safely carry a 200-lb. per sq.ft. loading with a lower relative stress upon the materials than the smaller load would cause at an early date. Plate resistance thus differs widely from beam resistance. In the latter some increase in strength is brought about by the increased compressive resistance of the concrete, but this is small compared to the great increase in strength of plate resistance caused by the radical increase in shearing rigidity of the concrete with age. Whereas, nearly all other kinds of construction deteriorate in strength with time, plate resistance of reinforced concrete floors develops greatly increased strength as the years go by and its record of service increases.

Some idea of the extent of the magnitude of this phenomenon may be understood 50 years from now but it is hopeless to expect that it may be recognized by non-progressive reinforced concrete theorists whose mathematical analysis is founded upon contradictory assumptions without reference to the fundamental mechanical truths established generations ago in the theory of elastic resistance.

Minneapolis, Minn. C. A. P. TURNER.
Feb. 15, 1926.

Clay and Water

Sir—I was very much interested in learning of experiments on clay by W. Spring, recently called to my attention by J. Albert Holmes. These experiments obviously represented one of the intermediate steps in a series of investigations by chemists on the phenomenon of swelling of gels. The methods used and the results obtained did not come to my attention until quite recently.

For the purpose of admitting the water to the samples all investigators have used either semipermeable membranes or semipermeable vessels as did Mr. Spring, while I myself used sandfilters, filter paper taking the place of the membranes. Of the successive investigations I might mention the following: *Reinke* (swelling of laminaria); *Hanstein's* Botanische Abhandlungen, 1879, p. 1; 1901, *W. Spring* (swelling of clay); 1912, *E. Posnjak* (swelling of gelatin and of rubber); Kolloidchemische Beihefte 1912, p. 417. The investigations of Posnjak were the first to lead to a positive result, inasmuch as they proved that the time-rate of swelling approximately follows the law of reactions of the first order. However, at that point the investigations came to a standstill, because interpretation of the test results would have required a mathematical theory of the flow of water through capillary systems of variable dimensions, and such a theory did not exist. Eleven years later I succeeded in establishing this theory for another purpose (Wiener Akademie der Wissenschaften, Abt. IIa. 1923, pp. 125-138), but without knowing of Posnjak's test results.

Two months ago, when I learned about these results and tried to correlate them with my theory, I not only found the theory confirmed by Posnjak's tests, but, in addition, I obtained new results concerning the microstructure of gelatin. The work is not yet finished.

My conception that the capillary water contained in clays cannot completely evaporate has in the meantime been confirmed to a very surprising extent by independent experiments made by the Bureau of Soils. Concerning the part this residual water plays in producing the cohesion of the dry clay I beg to refer Mr. Holmes to my original publications, cited in my *Engineering News-Record* papers.

Cambridge, Mass. CHARLES TERZAGHI.
Feb. 3, 1926.

City Held Liable for Polluted Water

Two separate actions against the city of Everett, Wash., to recover damages for deaths alleged to have been due to drinking polluted water supplied by the city were decided against the city on Oct. 13 and 16, 1925, by the State Supreme Court of Washington (*Roscoe vs. City of Everett and Aronson*, do., 239 Pac. 831 and 1011; abstracted in U. S. *Public Health Reports*, Jan. 29). In each case, states this abstract, "the pollution was apparently due to contaminated river water reaching the city water through a bypass in the mill company's plant." A brief account of this instance of an outbreak of diarrhea, dysentery and typhoid, two deaths from dysentery and nine from typhoid, appeared in *Engineering News-Record*, July 10, 1924, p. 59.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Connecticut Society Meets at New Haven

Engineering Society Discusses Problems Largely Affecting the New England States

The Connecticut Society of Civil Engineers, one of the oldest state societies in the country, held its 42d annual meeting at New Haven, Conn., Feb. 16-17, with a total of 175 members and guests in attendance. Lecture rooms in some of the Yale University laboratories were put at the disposal of the society and as a result the technical sessions were held under much more advantageous conditions than many sessions of similar character.

The morning of the first day's session was given over to society business. In the afternoon three papers were considered; the Widening of Boston Post Road, by Arthur W. Bushell, division engineer, Connecticut State Highway Department; the Delaware River Bridge, by Clement E. Chase, principal assistant engineer, Delaware River Bridge Joint Commission; and Stream Pollution and Industrial Wastes, by James A. Newlands, president, the Henry Souther Engineering Co., Hartford, Conn. Mr. Bushell pointed out that despite the widening of Boston Post Road to a width sufficient for four lanes of traffic, it will be necessary to begin construction of a parallel route within a few years. Such a route, due to the high cost of real estate along the present Post Road, would have to be located north of it in more open country, a location which would necessitate the use of heavier grades.

Disposal of Industrial Wastes

A plea for co-operation between state commissions and industries which produce waste matter that pollutes streams was made by Mr. Newlands in his paper. He believes that much can be accomplished in the way of disposing of these wastes if the two parties can be gotten together to deal with the problem as one of common interest.

Earthquake Hazard

There was a large turnout of members and guests at the annual dinner, held Tuesday evening, to hear Dr. Hollis Godfrey, president of the Engineering-Economic Foundation, of Boston, speak on the subject The Earthquake Hazard Along the Northern Atlantic Seaboard. Dr. Godfrey prefaced his remarks by explaining the work of the Engineering-Economic Foundation as being that of studying and preparing for all types of major emergencies which affect the health or wellbeing of mankind, of which the earthquake is only one. On the matter of earthquake studies, he spoke of one for the city of Boston which the Foundation is making which shows the "rock and clay contours" underlying the city of Boston. The object of the survey is to make it possible for the city authorities to know where water mains and important structures which must be protected from earthquake hazard can be located with the greatest amount of safety.

Town Planning and Tidal Power

Wednesday morning was given over to a business meeting and to three technical papers, the first on Traffic and City Planning, by Laurence J. Carmalt, in which he stressed the importance of having a *comprehensive* rather than a complete plan for each city and then making all improvements tie into that plan. The second paper, Some Aspects of the Proposed Tidal Power Development at Eastport, Me., by Dexter P. Cooper, was read by one of the members of the society in Mr. Cooper's absence. The paper threw little light upon the engineering features of the proposed power development and as Mr. Cooper was not present to answer questions these features, which are of great interest to engineers, could not be discussed.

The morning session closed with a talk by Director Lull, of the Peabody Museum, a talk which was designed as a preface to the inspection of the museum which was to take place in the afternoon.

New Officers

Officers elected for the year 1926 are as follows: President, Joseph P. Wadhams of New Haven; vice-presidents, Vincent B. Clarke of Ansonia and George E. Hamlin of Hartford; Carlton T. Bishop and Harold L. Blakeslee, the retiring president, were added to the board of directors. The secretary, Clarence M. Blair, and the assistant secretary, F. J. Trowbridge, were re-elected. A. B. Hill and Dean C. H. Warren of Sheffield Scientific School were elected honorary members of the society.

Engineering Fifty Years Ago

From *Engineering News*, February, 1876

NEW YORK CITY consumes about 100 gallons of water per diem for each of its 1,200,000 inhabitants. It is computed that 300,000,000 gallons daily overflow the Croton dam.

Propositions looking to an increased supply of water for New York City have already been made, the present aqueduct and reservoirs being now barely sufficient for the demands of the city.

Philadelphia Bridge to Be a Toll Bridge

Pennsylvania Legislature Approves Bridge Tolls Plan; Reverses Prior Action

By an almost unanimous vote the lower house of the Pennsylvania legislature on Feb. 16 approved a bill providing for collection of tolls on traffic over the nearly-completed bridge over the Delaware River between Philadelphia and Camden, built jointly by New Jersey and Pennsylvania. The bill, which had already been passed by the upper house (see p. 209, Feb. 4) was signed by Governor Pinchot, and immediately thereafter the Delaware River Bridge Joint Commissions began the work of drafting a tolls agreement between the states, to be considered at a meeting of the commissions on Feb. 26.

This action reverses the action of Pennsylvania in attaching a proviso to its last appropriation for the bridge, a year ago, to the effect that the money should be expended only for a toll-free bridge. Last Spring this proviso was claimed by the city authorities of Philadelphia to be a permanent bar to collection of tolls by New Jersey, although the latter state had stipulated toll refunding as a condition in connection with its bond-issue referendum and its issue of bonds for the construction of the bridge. The Philadelphia claim caused the New Jersey commission to decline to act on any further contracts toward completion of the bridge. Pennsylvania later entered suit in the U. S. Supreme Court to enforce performance by New Jersey of the agreement to construct the bridge, which suit is still pending, in its preliminary stages. At the same time the Philadelphia *Record* undertook to learn by private postcard polls the sentiment of representative groups of citizens and road users on the tolls question, with the result of finding a great majority of sentiment in favor of toll collection for refunding purposes. The reversal of the Pennsylvania attitude by action of the legislature and governor now closes the deadlock between the states.

Final Contracts

Contracts for the work required to open the bridge to traffic are now being advertised by the commission, for bids to be opened March 3. These contracts cover the construction of metalwork, including railings, light standards, and similar work, the electrical equipment for the structure, the wrapping of the cables, and grading and paving need d on the Camden approach. The contracts require the work needed to open the bridge to traffic to be completed by July 4.

WASHINGTON NOTES

IN THE face of an unprecedented demand for the continuance of highway construction at the present rate, the Committee on Roads of the House of Representatives has recommended unanimously a $75,000,000 program for each of the two fiscal years to end June 30, 1928 and June 30, 1929. This is in addition to $7,500,000 approved for forest roads.

The American Association of State Highway officials had asked that the authorization be $80,000,000. Some of the states that had an accumulation of funds recently have been absorbing federal aid at that rate and more will be able to do so before this money is appropriated. The committee felt, however, that the $75,000,000 precedent should be adhered to.

It is expected that the road bill will be passed by the House before the end of March and that the Senate will act upon it before the end of the present session. The amount authorized probably will go through without change which will mean the expenditure of at least $100,000,000 on primary roads by the states themselves.

Voters of Saginaw, Mich., Choose Water Supply at Doorstep

After many years of controversy and reports on sources of water supply for Saginaw, Mich., the voters Feb. 8 approved the Saginaw River at their doorstep as their choice of a water supply. Three sources were under consideration, Saginaw Bay, 18 miles away, at a cost of $4,600,000; Sheawassee River, 8¼ miles away at $3,069,200 and the Saginaw River close to town at $2,749,400.

Courts had decided that a previous vote of the people of bonds for a ground water supply 50 miles away in Clare County was "advisory" only after Hood, Decker, Shoecroft & Drury and Maury & Gordon had reported against the proposed screme. The bonds can be used for any system the city officials elect but to clear the atmosphere, another vote was taken. A light vote was registered, the Saginaw River project receiving 5,893 votes, the Bay project 1,075 and the Sheawassee, 190. Sentiment for the nearby supply was crystallized by the combined drive of the State Conservation Department and State Board of Health to clean up the river. Orders have been issued that steps must be taken toward sewage disposal by all towns on the Saginaw River within six months. Saginaw itself is facing a $2,000,000 expenditure for disposal.

Estimate of costs for the main features of the Saginaw River water project are as follows: Intake to center of channel, $125,000; coagulating basin, $150,000; filters, 25 m.g.d., $325,000; filtered water basin, 10 m.g., $250,000; consolidated pumping station, 30 m.g.d., $425,000; 11 miles distribution extensions, 24 to 36-in., $845,000, 36-in. sewer, $84,500.

In the conclusions of the two firms of consulting engineers with reference to the specific question as to whether a permanent supply of 30 m.g.d. of good water could be developed from the Clare District it was stated that it was not practically possible to obtain such a supply either good or bad from the areas under consideration. Further it was stated that heavy and continuous pumping would sooner or later bring the underlying salty water within reach of the wells and ruin the supply beyond all hope of redemption. At one time three drills were sinking test wells in the exhaustive exploration work of the city and of the Layne-Bowler Chicago Co. That the area contained no contiguous pervious strata, thereby confirming the statements of geologists who had studied the territory, was the final result of the borings. This was also confirmed by the variable character of the quality of the water from nearby wells. No impervious barrier separates the upper fresh water from the lower salt water strata in the drift above the rock.

North Atlantic States Road Builders Convention

Highway Officials Hold Three-Day Meeting at Syracuse—Grade Crossings Discussed

Over a thousand highway officials and representatives of the industries connected with highway building took part in the proceedings of the second annual convention of the Association of Highway Officials of the North Atlantic States. The convention was held at Syracuse, N. Y., Feb. 17-19, and in connection some two-score of manufacturers arranged exhibits of road materials and equipment. The technical sessions occupied forenoon and afternoon of three days. A round dozen of formal papers were presented including four on railway grade crossing elimination. These related particularly to the New York situation following the $300,000,000 bond issue authorized at the last election.

Among experts who spoke were C. R. Vanneman, chief engineer of the New York State public service commission; W. M. Acheson, engineer of the middle division; William L. Dill, commissioner of motor vehicles, New Jersey; and George W. Kittredge, chief engineer of the New York Central Railroad.

It was pointed out the program would add $150,000,000 to fixed charges of railroads, on which interest must be paid, requiring a higher earning power, while the elimination work would add little if anything to income, perhaps reducing costs of operation considerably. Another factor cited was that of interrupting traffic schedules and handicapping a railroad if too many crossings on one road were placed on the elimination program. Officials agree the program is an excellent one, but that it will be a good policy to "make haste slowly."

The connection between safety on the highways and grade crossings was the subject of an address by Mr. Dill, who showed causes of accidents, effect of eliminating grade crossings and pointed out the relation of lives saved to cost of the work.

Conowingo Water Power Project Receives Federal License

The Federal Power Commission has issued a license for the construction of the Conowingo hydro-electric power development on the Susquehanna River in Maryland. The dam and power house will be built by a subsidiary of the Philadelphia Electric Co. The project has been approved by the public service commissions of Pennsylvania and Maryland except for the details of the plan of financing it.

Highway Safety Conference in March

The second National Conference on Street and Highway Safety will meet in Washington, March 23, 24 and 25, 1926. The first conference, called by Secretary Hoover, was held in Washington in December, 1924. Following that conference new committees were appointed which have been working ever since in the preparation of supplementary reports. These reports will be presented at the March meeting. The main subjects to be discussed this year are uniform laws for traffic control and methods of metropolitan traffic control.

Memphis Engineers to Build Memorial Hall

The Engineers Club of Memphis has undertaken the construction of a hall in memory of engineers lost in the sinking of the steamboat Norman last year, to be known as Norman Memorial Hall, a $30,000 structure of architectural beauty, for use of the Boy Scouts. The hall will have 23 entrance columns each bearing the name of one of the men and women lost in the disaster. A. S. Fry, chairman of the memorial committee, reported that the project would be well under way by the date of the first anniversary, May 8.

Massachusetts Engineers Seek Higher Wages

The Massachusetts State Engineers' Association and allied technichians in the employ of the Commonwealth believe that the low pay which they receive is demoralizing and impairing public service. They are now attempting to secure legislation which will correct this classification by bringing it under the division of civil service.

According to James H. O'Connor, secretary of the organization $2,406 is the average yearly salary and $3,800 is the average to men of 25 years' experience. Elmer C. Houdlette, president of the association has informed the legislative committee on Public Service that this condition has caused distrust, discontent, and want of security, and that it is forcing many valuable men into the industrial field when their services are needed by the state.

The Commonwealth Service Association, an organization of state employees has presented a similar petition to the Committee on State Administration. Many state officials holding technical offices have joined the effort.

Ohio Highway Engineers School

The first highway school for engineers of the Ohio Department of Highways and Public Works was held at Columbus, Ohio, during the first week in February under the direction of George F. Schlesinger, state highway engineer. In addition to the engineers and superintendents of the Highway Department, a number of students from the Ohio State University and county engineers attended the meetings.

Special Meeting of A. P. H. A. at American Health Congress

A special meeting of the American Public Health Association will be held at Atlantic City, N. J., May 17 to 22, as a part of the American Health Congress. Among the topics are training of sanitarians, publicity, water pollution by industrial wastes, ideal health administration, and qualifications and duties of health officers. The regular annual meeting of the A. P. H. A. will be held at Buffalo, N. Y., Oct. 11 to 14. For details as to either meeting apply to the American Public Health Association, 370 Seventh Ave., New York City.

Colorado River Development Bill in Committee

The Committee on Irrigation and Reclamation of the House of Representatives is trying, rather unsuccessfully, to agree on a bill putting in legislative form a plan for the development of the lower Colorado River along the lines suggested recently by the Secretary of the Interior.

The unintroduced bill before the committee provides for a dam in the Colorado at Boulder or Black Canyon to create a reservoir to contain not less than 26,000,000 acre-feet. The measure provides also for the construction of the all-American canal, but Secretary Work has suggested an amendment providing that the canal is to be built only if Mexico is unwilling to modify the present concession, limiting the amount of water to which Mexican irrigators are to be entitled.

The $125,000,000 needed for the development is to be borrowed on the credit of the United States for repayment during a period not to exceed fifty years.

Representative Hayden, of Arizona, a member of the committee, is bitterly hostile to the measure as it provides for the ratification of the Colorado River compact, when six of the seven states in the Colorado basin have approved it.

The bill requires the sale of power at the switch board at such rates as will permit of the retirement of the bonds within the fifty year period. Under the strict requirements of the bill operation of the power plant need not be conducted necessarily by the government, as a proviso specifies that the Secretary of the Interior may enter into contracts for units of the plant "with right to generate electrical energy."

Making Schedule of Water Rights for Kings River Storage

The Kings River water conservation district, under which it is proposed to develop storage for the joint use of irrigation organizations on Kings River, Calif., some time ago appointed a board of engineers and appropriated funds for preparing a schedule of water rights, such as will enable the state irrigation board to call an election for voting bonds. The engineers are Max Enderlein and George Swendsen of Fresno, and H. L. Haehl of San Francisco, and their report is expected to be completed sometime in the near future. Funds for the study were appropriated from a joint fund recently raised by an assessment of 2c. per acre on the one million acres of land that will be affected by the proposed work. Previous reference to the general plan of developing storage on the Kings River appeared in *Engineering News-Record*, Dec. 29, 1921, p. 1053.

Engineering features of the project have been reported on repeatedly, the state engineer has approved the plans and the state irrigation board has passed favorably upon them but before bonds can be voted the various irrigation districts, mutual companies and riparian owners must join in the adoption of a schedule of water rights so that there will be a definite understanding about the claims on the stored water. The preparation of such a schedule is complicated by the multiplicity of rights, the many overlapping and conflicting provisions, appropriations, court decisions and priorities. More than one hundred effective priorities are being considered in making up the schedule. One of the most important features of the work in which the board is now engaged is the translation of recognized rights from units of flow to units of storage. That is, the schedules as now existing deal wholly with quantities in second feet, often with a stipulated relation to total flow at some particular time. These rights must now be expressed and apportioned in terms of acre feet of storage.

Features of the proposed storage scheme would be the construction of a 300-ft. dam at the Pine Flat site in Kings River canyon, four or five miles above Piedra where it is considered economical to develop 600,000 acre feet of storage. The hydro-electric power plant in conjunction with the storage scheme would develop 200,000,000 kw.-hr. annually which it is expected to sell to power companies to pay interest charges.

Engineering Foundation Elects New Officers

At the annual meeting of Engineering Foundation Feb. 11, the following officers were elected for the ensuing year: chairman, Lewis B. Stillwell, vice-chairmen, Elmer A. Sperry and George A. Orrok; additional members of executive committee, J. Vipond Davies and Arthur M. Greene, Jr.; Director and secretary, Alfred D. Flinn, and treasurer, Jacob S. Langthorn.

Back Income Tax Relief for State and Municipal Employees

State and municipal employees are relieved from payment of *back* income taxes under the Federal tax bill as finally adopted by the conference Committee on Feb. 19 and agreed to by the House on Feb. 23. It is expected that the Senate also will agree to the report and that it will be approved by the President by the end of this week. The amendment reads: "Any taxes imposed by the Revenue Act of 1924 or prior revenue Acts upon any individual in respect of amounts received by him as compensation for personal services, as an officer or employe of any State or political subdivision thereof (except to the extent that such compensation is paid by the United States Government directly or indirectly) shall, subject to the statutory period of limitations properly applicable thereto, be abated, credited or refunded."

This amendment replaces a longer one to the same effect inserted by the Senate in the House bill. Its design is to put all state and municipal employees in the same class as regards income taxes from 1918 to 1924, the Government having regarded all as exempt for some years, and then having started to collect these taxes back to 1918 from water-works and other municipal employees engaged in what were claimed to be non-governmental functions, while still exempting all other municipal employees.

Engineering Society is Holding a Concrete School

A two week's program in design of concrete mixtures and field control of concrete is being offered to engineers and other concrete men of Detroit and vicinity by the Detroit Engineering Society.

The course which began Feb. 23 and is held at the club house at 7:30 p.m., is intended not only to give a clearer understanding of the factors which affect the strength and quality of concrete, but also to provide practical exercise in the actual design and proportioning of concrete mixtures to meet given strength specifications. It is purely educational, having as its aim the presentation of the latest improved methods in the proportioning of concrete mixes.

Instruction will be given in the standard methods of taking samples, making the necessary measurements and tests, and of controlling the quality of concrete in the field. In addition, lectures will be given on general phases of concrete work of interest to all engineers. Problems will be worked out, using aggregates available in the vicinity of Detroit, in which the correct proportions will be determined for the desired strength and quality.

The meetings are being conducted by J. W. Kelly of the staff of the Structural Materials Research Laboratory. E. L. Brandt, secretary, states that the registration charge is $1 to cover the cost of text books and other incidental expenses. Similar schools have been conducted in other cities.

Wisconsin Engineers Meet at Madison

Perfect Arrangement for Combined Publication of Proceedings with Other States

With the entrance of the Engineering Society of Wisconsin into an arrangement with the Iowa and Illinois societies to publish their proceedings jointly the proposal becomes operative. The same resolution, passed by the Illinois Society of Engineers at the Elgin meeting, was favorably passed at the meeting of the Wisconsin engineers held in Madison Feb. 18, 19 and 20. Quarterly publication to gain second-class mailing privileges, a single mailing list and a single printer are some of the advantages sought. The Illinois proceedings will come out in April, Wisconsin in July and Iowa in October. The January number will be a joint issue. Editorial contents of each issue are to be under the control and direction of the secretary of the society to which the issue is devoted. Expenses are to be divided in proportion to the pages of editorial matter published by each society.

Co-operation

Further co-operation was urged at the meeting between the State Board of Health and the industries, particularly the paper mill operators and pea packers. For the study of paper mill pollution, $10,000 is available from the State Conservation Commission in conjunction with the State Board of Health. The Pea Packers Association has appropriated $500 for waste investigations. C. M. Baker, state sanitary engineer is of the opinion the solution lies in better recoveries of the paper mill wastes and in local treatment for the pea cannery wastes.

High spots in the program involved a symposium (three papers and a report) on sewerage and sewage disposal, two papers on water supply, an excellent discussion of the garbage collection in Milwaukee, several phases of street transportation, a discussion of material inspection experience and financial problems under the city manager form of government. Frank R. King, State Board of Health, outlined progress in the sewerage in the State. Private sewerage systems known now number 9,000 with 500 to 800 being installed annually. The State Board of Health has made up a large number of stock plans for small disposal plants which it hands out gratis with blank dimensions filled in to suit the situation. These cases are all too small for the engineer to handle.

Operation of disposal plants in Wisconsin are too often neglected particularly in the smaller cities. Prof. C. I. Corp, University of Wisconsin, detailed his experience in finding flooded filter beds, clogged Imhoff tanks and some plants by-passed entirely. The trouble is largely ignorance because of political change of operators to those of little intelligence.

The preaeration of sewage at the plant at Birmingham, England, to increase the capacity was described by R. G. Rankin, consulting engineer. The arrangement seems to increase the capacity of sprinkling filters two or three times. Experiments at Decatur, Illinois, where the sewage carries a heavy charge of starch wastes with a biological oxygen demand of 790 p.p.m. indicated a reduction by Imhoff tanks to 600 p.p.m. and by 3-hours preaeration of the Imhoff effluent from 600 p.p.m. to 319 p.p.m. The filters taking this preaerated sewage could be speeded up from 1 m.g.d. per acre to 3.3 m.g.d. per acre.

L. F. Warrick, State Board of Health, outlined the paper mill waste problem giving in detail the process, recoveries possible and the co-operative work which the State Board of Health is doing with the mills. The most favorable scheme now proposed to handle the sulphite liquors is that of evaporation and burning under the boilers of the plant since the concentrate has a certain heat value.

E. E. Parker, city engineer, Madison, said in discussion that preaeration was provided for in the design of the new Madison plant but would not be built until the added capacity was required.

The Nekoosa-Edwards Paper Co., near Fort Edward, Wis. on the Wisconsin River, has recently installed a new water supply taken from Four-Mile Creek nearly a mile away and across the Wisconsin River. E. P. Gleason, engineer for the paper company, stated in his paper, prepared jointly with C. F. Walson, that three ground waters containing iron and two turbid surface waters were rejected. The Four-Mile Creek has iron but by long-time sedimentation (2 days) in a dike-baffled basin after application of a small dose of alum the iron is dropped. The cost of the creek water was cheaper than $40,000 annual treatment cost of the turbid Wisconsin water at the site.

Transportation

The regional planning of Milwaukee County in laying out a major street plan to fit that of the city, was described by Ray Behrens, engineer, Milwaukee County Regional Planning Department. J. T. Donaghey, state highway engineer, deplored the tendency of filling stations to seize all the odd, choice bits of land that should be made into parks. His main topic, however, was the traffic problems on the main street entrance to small cities. Early widening of the entrance street or bypassing the main street was his answer.

A spirited discussion of the inroads of the bus on street car business was handled by Prof. L. F. Van Hagan, University of Wisconsin, who gave statistics compiled from the census and McGraw-Hill publications, indicating a continued recession in street car mileage since 1918, due largely to the motor bus.

A. A. Oldfield, engineer, Wisconsin Power & Light Co., was of the opinion both services were here to stay. The bus can never handle rush hour traffic in his opinion. Much of the street car mileage abandoned should never have been built he said.

Henry Traxler, city manager, Janesville, said the first problem and the easiest of a city manager was to reduce taxes but eventually the same amount of money would be spent but on more service. Streets would be paved and maintenance taxes reduced. Health and recreation features usually were greatly increased. C. M. Osborn, city manager, Kenosha, spoke of reducing per capita taxes from $27 to $20 by collecting them, consolidating purchases and the budget system.

Joseph P. Schwada, city engineer, Milwaukee, described the truck-and-trailer garbage collection system by which the costs and complaints have been reduced. In 1921 the cost was $5.79 per ton in 1922, $5.56; in 1923, $5.10; in 1924, $4.65 and in 1925, $4.50. Complaints beginning with 1922 have been respectively as follows: 23,082; 23,858; 7,711 and 3,546 in 1925.

The newly elected officers are as follows: President C. M. Baker; vice-president, G. E. Heebink.

Highway Program in Illinois Will Lag in 1926

Although Illinois citizens voted $100,000,000 in 1925 to complete the state highway system, none of it can be used until the proceeds of a previous $60,000,000 issue have been expended. About 225 miles of roads on the $60,000,000 system involving about $6,000,000 are delayed for the following reasons: On 25.47 miles right of way has not been secured, though satisfactory progress is being made. Progress in securing right of way is unsatisfactory due to factional fights on 136.19 miles. Dissension and delay on the part of local people account for 20.13 miles and court proceedings have prevented construction in 43 miles. In consequence of the above, the 1926 mileage built in Illinois will be materially less than for some years.

The Illinois Association of County Highway Superintendents is attempting to interest chambers of commerce and like bodies to bring local pressure on the various obstacles erected against the completion of the $60,000,000 program so that the new money can be made available.

Proposed Florida West Coast Route for the Seaboard

In addition to the railroad developments in Florida noted in the *Engineering News-Record* of Feb. 11, 1926, p. 243, a recent report of President S. Davies Warfield of the Seaboard Air-line Railway Co. says that an application is about to be made to the Interstate Commerce Commission for permission to construct the proposed Seaboard West Coast Line to the West.

This will give the Seaboard system a third line of railroad to Tampa and St. Petersburg, the route to follow the West Coast northward to Perry, Florida, thence to Montgomery and Birmingham, Ala. There is to be a line to Atlanta and one from Atlanta to Jacksonville via Macon, Ga. This will open a new short line route from the West via Birmingham and Montgomery, also from Atlanta via the proposed Inglis-Dunnellon-Wildwood cut-off to Palm Beach and the East Coast.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 23-26, 1926.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 9-11, 1926.

NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY, Washington, D. C.; Second Annual Conference, Washington, D. C., March 23-25, 1926.

NATIONAL CONFERENCE ON CITY PLANNING, New York City; Annual Meeting, St. Petersburg, Fla., March 29-31, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Spring Meeting, Kansas City, Mo., April 14-16, 1926.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, N. J., May 10-13, 1926.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, State University of Iowa, Iowa City, June 16-18, 1926.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J.; June 21-25, 1926.

INTERNATIONAL CITY MANAGER'S ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

The Illinois Section of the American Society of Civil Engineers has elected L. R. Harza, consulting hydraulic engineer, Chicago, as president for 1926, in place of J. N. Hatch, who had been elected in January but declined to accept the position. The secretary, W. D. Gerber, was re-elected.

The Wyoming Engineering Society meeting January 22 and 23 at Casper elected the following officers: Elmer K. Nelson, president; W. C. Newell, vice-president, and J. Q. Naret, Cheyenne, secretary-treasurer. Among the speakers were J. F. Seiler, bridge engineer, Wyoming State Highway Department, on "The Highway Situation in Wyoming"; Dean Earl D. Hay, Wyoming State University on "Present Day Tendencies in Engineering Education and Curricula"; Frank C. Emerson, state engineer, on "What Our Water Resources Mean to Wyoming." Resolutions passed urged the appointment of a state sanitary engineer, endorsed the Water Resources Inventory (H. R. 6358) and called on the U. S. Geological Survey to complete the topographic maps and geological folios of Wyoming.

The Utah Section, American Society of Civil Engineers, at its annual meeting held at Salt Lake City, Feb. 4, endorsed the action of the Utah Engineering Council opposing the changing of technical employees for political reasons. The action was brought about by a report that the chief engineer of the State Road Commission was to be discharged simply for political purposes. H. S. Kerr, assistant chief engineer, Utah State Road Commission, was elected president of the section; Murray Sullivan, assistant to the president, Salt Lake & Utah R.R., was elected a vice-president, and H. S. Kleinschmidt, consulting engineer, Salt Lake City, was re-elected secretary-treasurer.

Oklahoma Chapter, American Association of Engineers, will hold its annual meeting at Oklahoma City on March 6. The student chapter of Oklahoma A. & M. College will participate.

Personal Notes

J. R. McAULIFFE, Longview, Wash., who was formerly construction superintendent for J. D. Hanley, announces the formation of a firm, J. Roy Mc Auliffe, Inc., to engage in general contracting.

BAYARD F. SNOW, formerly resident construction engineer on the Providence, R. I., aqueduct, has been appointed resident engineer for the South Essex Sewerage District, Commonwealth of Massachusetts, with headquarters at Salem, Mass.

WALLACE W. SOUTHARD, chief deputy county surveyor at Indianapolis, Ind., has been named county surveyor to succeed GEORGE G. SCHMIDT, who resigned to become city engineer. Mr. Southard has a wide experience in engineering, having been employed continuously during the last ten years either by the city, county or state.

W. C. TURNER, chief engineer of Pierce County, at Tacoma, Wash., has resigned to enter the race for city commissioner. Mr. Turner has been engaged in engineering work in that county for thirty-six years, since 1922 being connected with the county engineer's office, as chief engineer.

W. E. CONROY, superintendent for A. Guthrie & Co., contractors for the Ozark tunnel on the Edgewood-Fulton line of the Illinois Central R.R., has been appointed superintendent on their work for the Cascade tunnel on the Great Northern Ry. He is succeeded by LEONARD OTT at the Ozark tunnel.

G. A. HANSON, Tampa, Florida, has established the firm, G. A. Hanson, Inc., for general building construction in Tampa. Mr. Hanson is a graduate of the polytechnic institute at Auburn, Ala., was for a time connected with the Aberthaw Construction Co. in Boston, and more recently with the G. A. Miller Company which has handled building construction in Tampa and South Florida.

SAMUEL A. TAYLOR, consulting civil and mining engineer, Pittsburgh, Pa., has been elected president of the American Institute of Mining and Metallurgical Engineers.

Obituary

GEORGE MATHES, member of the senior class in civil engineering, University of Tennessee, was drowned in the Tennessee River Feb. 9, while engaged in making soundings for a pipe line crossing for the city of Knoxville.

PHELPS JOHNSON, builder of the Quebec bridge and more recently chairman of the board of directors of the Dominion Bridge Co., died Feb. 20 in Montreal, aged 76 years. A biographical sketch of Mr. Johnson and outline of his work will be given in these columns next week.

J. H. PURDY, senior vice-president of the American Water Works & Electric Co., Pittsburgh, Pa., died in a hospital in Pittsburgh Feb. 16, at the age of 77 years. Mr. Purdy had been for many years with this company and with its predecessor, the American Water Works & Guarantee Co., and under his direction were built many water plants.

R. R. GOVIN, president of the *Journal of Commerce* publishing company and head of the United States Asphalt & Refining Co., died of heart disease at Monte Carlo, Monaco, Feb. 16, aged 58 years. Mr. Govin was born in Cuba, and graduated from Columbia University and from Columbia Law School. He was proprietor of several newspapers and president or director of several industrial companies.

JAMES H. WHITNER, vice-president of the Virginia Bridge & Iron Co. died at Roanoke, Va., Feb. 10. Mr. Whitner was born in Anderson, S. C., in 1861, and graduated from Rensselaer Polytechnic Institute in 1885. He had been associated with the Virginia Bridge & Iron Co. since 1898, first in charge of its southern contracting office at Birmingham, and for more than twenty years in charge of its contracting department at Roanoke, Va. For the past eight years he had been vice-president in charge of contracting.

MORRIS RIGGS, manager of the Toledo plant of the American Bridge Co., died Feb. 7 at his home in Toledo, Ohio, aged 64 years. Mr. Riggs was born in Iowa and graduated from Iowa State College. He entered the Minneapolis office of the Smith Bridge Co. of Toledo and in 1887 was transferred to its home office in Toledo. In 1890 the company's name was changed to Toledo Bridge Co. and Mr. Riggs was made its chief engineer. Later the company was taken over by the United States Steel Corporation and then merged into the American Bridge Co., Mr. Riggs becoming general manager of this Toledo branch.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Institute of Steel Construction Extends Activities

Extension of its activities is announced by the American Institute of Steel Construction. A department of architectural relations is to be organized, and three field engineers will be engaged, "to work with architects, engineers, owners, bankers, and others interested in building construction to promote the use of structural steel." The field engineers will also co-operate with technical schools and colleges. A. T. North, recently engineering editor of the *American Architect*, has been engaged as head of the department of architectural relations, and will undertake immediately the preparation of a sales manual for the use of the members of the institute.

This increase of activity is made possible by an increased rate of assessment on members, approved at the convention of the institute held last November. To provide space for the increased staff, the institute will shortly move to larger quarters at 285 Madison Ave., New York.

Business Notes

LAMBERT HOISTING ENGINE CO., Newark, N. J., manufacturer of steam, electric and gasoline hoists and derricks, log skidders and cableways, has a number of territories open for distributors.

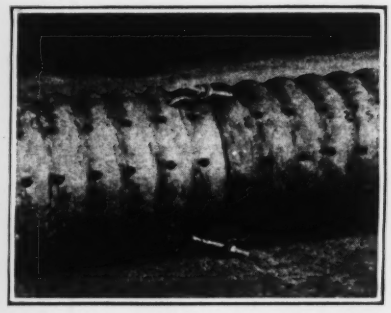
WALTER S. KIRKPATRICK, general superintendent, Castalia Portland Cement Co., Pittsburgh, Pa., died on Jan. 5. Mr. Kirkp trick had been with the Castalia company for 25 years, starting as assistant chemist after his graduation in 1901 from the University of Pittsburgh.

Equipment and Materials

Perforated Culvert Pipe for Roadbed Subdrainage

Corrugated galvanized iron culvert pipe, perforated in the valleys of the corrugations for two-thirds the way around the circumference, the bottom one-third being left solid, is a new development of the Armco Culvert & Flume Manufacturers Association, Middletown, Ohio. It is claimed that the perforated pipe has the same strength and flexibility as standard Armco corrugated iron culvert pipe and that it is entirely adequate to carry the traffic of heavily loaded tracks.

The holes are large enough to admit water freely but small enough to prevent the entrance of solid matter. The adjoining sections of pipe are held together by two hook bolts easily connected by one man with a wrench. In-



stallation is made by placing the pipe in the trench and filling above with broken stone or ballast to provide an open course for the water that has percolated down from the roadbed.

Uses recommended for this perforated pipe are: railroad yard drainage; track pan drainage; drainage of tunnels and of open cuts; for use around water stations and industrial tracks and for sidehill drainage.

Use of Oil-Electric Locomotives Extended During 1925

According to the General Electric Co., a marked interest was shown in oil-electric locomotives and cars by the railroads during 1925. About a year ago a 60-ton oil-electric locomotive was built jointly by the General Electric Co., Ingersoll-Rand, and the American Locomotive Co. and placed in trial service on a number of roads. This unit consists of a 300-hp. engine direct connected to a d.c. generator which in turn supplies power to four geared motors. As a result of the successful demonstration of this unit, six roads will soon have similar locomotives in service. These roads are the B. & O., the Lehigh Valley, the D., L. & W., the Erie, the Chicago & Northwestern, and the Central of New Jersey. In addition, the Long Island R.R. is using a 100-ton unit. This type of locomotive is now being used only in switching service.

In the application of the oil engine to the propulsion of electrically driven motor cars, the Canadian National Ry. practically completed seven single cars approximately 60 ft. in length. One of these cars recently traveled from Montreal to Vancouver in three days. The route of 2,937 miles was covered at an average speed of 43½ m.p.h. During the time the oil engine was running continuously. The Staten Island R. R., subsidiary of the B. & O., placed 90 motor cars in operation during the year.

The two 170-ton freight locomotives and the seven 100-ton switching locomotives for the New York Central R.R. are now being delivered. The motor generator type locomotives under construction for the New York, New Haven & Hartford R.R. are designed to take 11,000 volts a.c. current from the trolley through a motor-generator on the locomotive for the supply of d.c. to the geared driving motors. Tests have already been conducted on the initial units.

Automatic Railway Substations Are Increasing in Size

The most noticeable trend in the automatic railway substation field during 1925 was, according to the General Electric Co., the tendency toward the use of large sized units. Conspicuous examples of this tendency are two 2,000-kw. synchronous-converter equipments for the Boston Elevated Railway, six 1,000-kw. converters for the Melbourne and Metropolitan Tramways Board, two 1,500-kw. motor generator equipments for the Pacific Gas & Electric Co., and three 1,500-kw. converter equipments for the Chicago, North Shore & Milwaukee R.R.

Included in the equipment for conversion of the Chicago, Lake Shore & South Bend Lines, locally known as the "South Shore," from 11,000 volts single phase trolley to 1,500 volts d.c. are eight substations, six of which will be

automatically controlled. Of these eight stations, four will be equipped with synchronous converters, two of which will be manually operated and two automatically controlled. The other four substations will be equipped with mercury arc rectifiers. All of these rectifier stations will be automatically controlled.

Since the introduction of the high speed circuit breaker in 1916 for the protection of the Chicago, Milwaukee & St. Paul Ry. substations, a total of more than 900 units has been placed in service, and have given adequate protection even under the severest short-circuit conditions. Recently, the Japanese Imperial Government decided to use 50 of these units in the 1,500-volt substations forming a part of the electrification of the state railways.

The Key System Transit Co. is installing on a mole at Oakland, Calif., a motor generator set consisting of a 1,500-kw. generator and a 1,900-kva. synchronous motor with automatic control, which also takes care of the two incoming lines. A special feature is the use of d.c. control power from a small generator on the voltage regulator set. This is the first counter-e.m.f. regulator motor-generator set to be installed on the Pacific Coast.

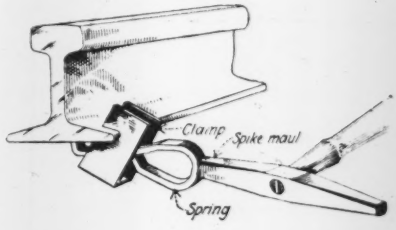
Huge Electric Locomotives Built for Virginian Railway

The electric locomotive illustrated herewith is said to be the largest locomotive of any kind ever placed in service. It also represents the delivery of the largest tonnage in locomotives ever built by the Westinghouse Electric & Manufacturing Company on a single order—7,700 tons. The combined locomotive capacity is 70,000 hp. continuous, or a tractive effort of 1,620,000 lb. with a maximum available tractive effort of 3,600,000 lb. Each locomotive has a continuous rating of 6,000 hp. at 28.4 m.p.h. The continuous tractive effort of each locomotive is 135,000 lb. at 14.2 m.p.h. with a starting tractive effort of 300,000 lb. These locomotives are 152 ft. 3 in. long overall, each one weighing 642.5 tons, of which 472.6 tons is carried on the drivers.

These engines are being used by the Virginian Railway for heavy grade service. Two of them are capable of taking a 6,000-ton train up the heaviest grade on the railroad, while one of them hauls a 9,000-ton train on the lighter grades.

Rail Anchor Cannot Be Overdriven

The new rail anchor that is being marketed in this country by the American Fork & Hoe Co., Cleveland, Ohio, has many advantages claimed for it, among which are the facts that it cannot be overdriven and is capable of re-



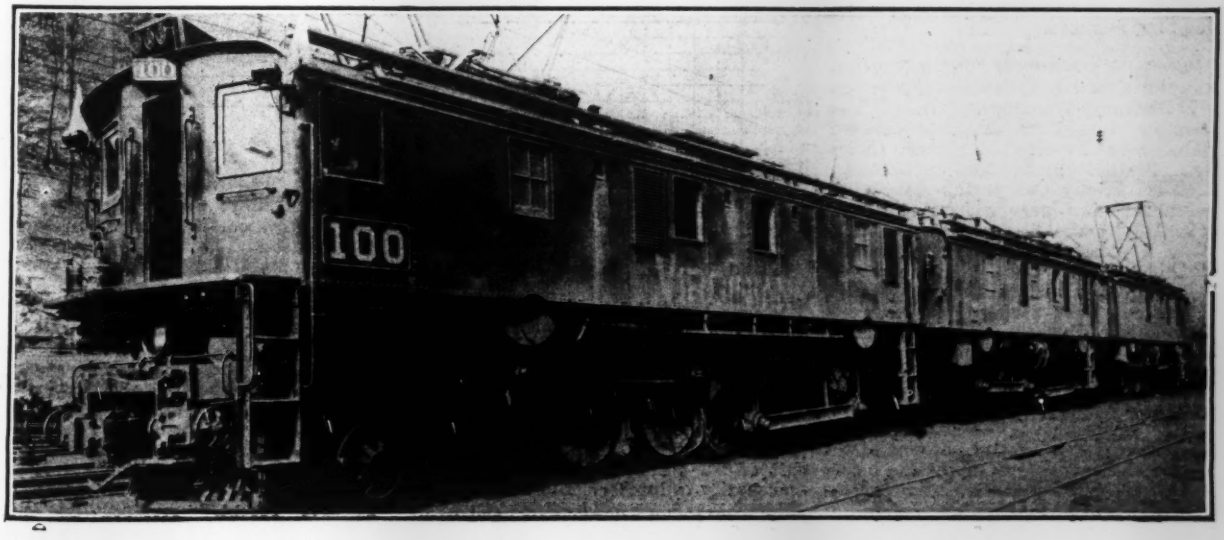
application many times. This anchor has been extensively used for some time on the railway systems in Canada. It is manufactured of special carbon steel carefully tempered and treated.

The anchor consists of two parts—a clamp and a spring. In applying the anchor the clamp is first placed preferably on the inside flange of the rail base with its face against the tie. The spring is then inserted, small end first, between the arms of the clamp, and tapped up until it binds between the bottom of the rail and the inclined web of the clamp as shown in the illustration. At this stage a heavy blow with a spike maul on the loop end of the spring usually suffices to drive the spring home so that the hook of the spring grips the opposite side of the rail base. The spring can be easily removed for resetting or re-application by driving the hook off the rail flange. No excavation or removal of ballast is necessary to apply the anchor. There is a flat surface of 5½ sq.in. presented to the tie when the anchor is attached so that it is claimed to be impossible for the clamp to twist or ride over the tie.

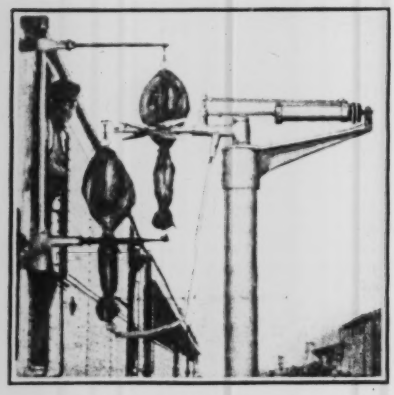
Among other advantages claimed for this rail anchor are the following: It accommodates itself to varying rail base dimensions; it automatically provides in the strong reaction of its spring an adequate take-up for ordinary wear and corrosion. It is claimed that it is practically impossible to move this anchor along the rail and therefore when readjusting or renewing ties, the anchor must be disengaged and re-applied. It is said that this can be done quickly and without causing any damage to the rail anchor.

Mail Exchanging Apparatus

A railway mail exchanging device introduced by the Spokane Mail Equipment Co., Spokane, Wash., has a track crane which takes the sacks from the mail car of a passing train, besides holding the outgoing sacks to be taken off by the car. This device, which is in use on the Spokane International Ry., includes a mail crane at the side of the track and a special attachment on the mail car. In addition to the arms for carrying the outgoing sack, the mail crane has a pair of catcher forks at the top connected with a horizontal pneumatic cylinder. These parts are all carried by a revolving head, a spring accelerating the rotation when the exchange is made at low speed. On the car is an upper arm to carry the sack to be delivered and a lower arm with forked catcher to pick off the sack suspended in the mail crane. Instead of throwing the sack from the car by hand, as is ordinarily done, the mail clerk attaches it to the upper arm of the car apparatus, which is then swung outward so that it will engage the catcher forks on the track crane. The sack on this crane is suspended in the usual way. As the two appliances engage, the sacks are exchanged and the arms of the crane and car apparatus swing round horizontally, the shock being ab-



sorbed by pneumatic cylinders. This mail exchanging apparatus was invented by Wm. O'Hara, Spokane, Wash., and perfected by H. E. Smith, mechanical engineer for the Spokane Mail



Equipment Co. The Bureau of Safety of the Interstate Commerce Commission has reported that it has advantages in the direction of efficiency and economy.

Publications from the Construction Industry

Culvert Placing—ARMCO CULVERT & FLUME MANUFACTURERS' ASSOCIATION, Middletown, Ohio, has issued a bulletin entitled "Reducing the Cost of Culvert Placement," in which is given a recommended practice for jacking Armco corrugated culverts through existing embankments.

Automatic Switching Equipment—GENERAL ELECTRIC CO., Schenectady, N. Y., has issued a 23-page bulletin, GEA-295, describing the application of its automatic switching equipment to railway service, hydro-electric generators, mining and industrial service, etc.

Scales—TOLEDO SCALE CO., Toledo, Ohio, has issued a small folder entitled "The Measurement of Materials." The booklet is a general exposition on weighing methods.

Foreign Machinery Markets—DEPARTMENT OF COMMERCE, Industrial Machinery Division, Washington, D. C., has recently issued a booklet entitled "Analyzing Foreign Machinery Markets Statistically." The publication sketches briefly the usefulness of the industrial machinery export statistics compiled by the department and contains a glossary of the classification effective Jan. 1, 1926. An appeal is made to manufacturers to co-operate to the extent of seeing that their export declarations are properly made out.

Alumina Cement—ATLAS LUMNITE CEMENT CO., New York City, in its new booklet gives about 70 pp. of illustrations and descriptions of the use of its new quick-hardening cement. The booklet is entitled "Full-Strength 28-Day Concrete Within 24 Hours."

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

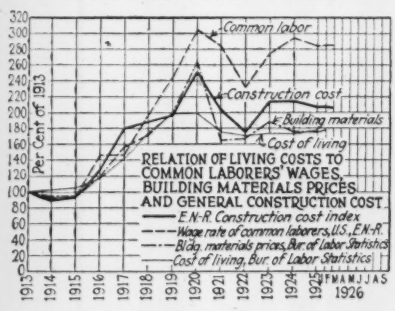
Week Ending	Public Work	Private Work	Total Contracts
February 25, 1926	$10.278,000	$27,116,000	$37,394,000
February 18, 1926	17,926,000	38,562,000	56,488,000
February 26, 1925	10,848,000	24,426,000	35,274,000
Heaviest Week			
1926, Jan. 21	22,012,000	39,472,000	61,484,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	121,844,000	248,835,000	370,679,000
1925	116,270,000	209,892,000	326,162,000

Cost of Living and Building Materials At Same Level Compared With 1913 Base

Gain of 137 per Cent in Wages Compared With Increase of Only 37 per Cent in Purchasing Power of Dollar

COST of living and the composite price of basic building materials were at exactly the same level at the close of January, 1926, according to the Bureau of Labor Statistics. Compared with 1913 as 100 both showed an index number of 177.9.

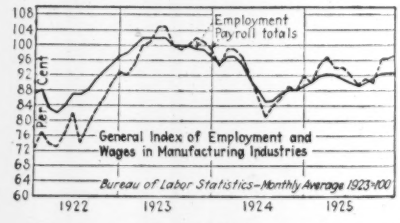
In the accompanying chart, the January rise of 0.5 per cent in building materials, which brought them up to the living cost level, was also shown in a corresponding increase (0.5 per cent) in the *Engineering News-Record* Construction Cost Index Number.


Common labor
Construction cost
Building materials
Cost of living
Per Cent of 1913
RELATION OF LIVING COSTS TO COMMON LABORERS' WAGES, BUILDING MATERIALS PRICES AND GENERAL CONSTRUCTION COST
E.N-R. Construction cost index
Wage rate of common laborers, U.S., E.N-R.
Bldg. materials prices, Bur. of Labor Statistics
Cost of living, Bur. of Labor Statistics
1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926

The net increase just mentioned was due to a one per cent rise in lumber and 0.3 per cent in brick, compared with a drop of 0.3 per cent in other building materials. Steel prices remained stationary.

The drop in general construction cost of 0.2 per cent in February, was due mostly to lumber. Blocked Florida shipments threw considerable quantities of pine lumber upon the market and when this condition is relieved in the early spring, a price reaction is anticipated.

Obstruction of navigation by ice keeps the brick market up, while steel and cement show no tendency to fluctuate. The trend in the minor materials is temporarily downward.


Employment
Payroll totals
Per Cent
General Index of Employment and Wages in Manufacturing Industries
Bureau of Labor Statistics—Monthly Average 1923=100
1922 1923 1924 1925

The upward trend in employment and factory pay-rolls, evident since July, 1924, has, like freight loadings, been dependent to a very great extent upon the automotive and construction industries.

Since June, 1923, the comparatively slight fluctuations in cost (labor and materials) have probably produced the uneven but nevertheless decidedly upward trend in volume.

A glance at the chart showing the relation of living costs to other costs shows that the former was comparatively high during the years 1914 and 1915. Since 1923, however, the cost of living has been below that of materials and labor.

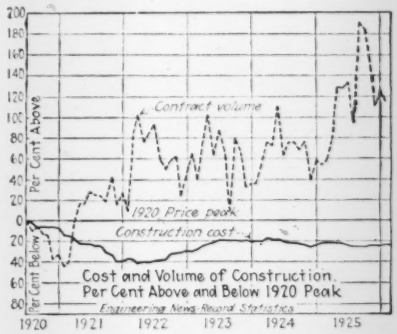
Figures recently released by the

Bureau of Labor Statistics show union rates of wages per hour to be 137.9 per cent above the 1913 base. This looks very favorable to the laborer, at first glance, especially when it is considered that living costs (average for 1925) were but 73.5 per cent above 1913, and 77.9 per cent higher than 1913 in December, 1925.

The gain of 137.9 per cent in wages appears smaller, however, when it is considered that the relative purchasing power of wages as measured in living costs has increased only 37.1 per cent since 1913.

This might be interpreted as meaning that the 1913 wage level was so low, compared with living costs at the time, that even a gain of 137.9 per cent in wages has not been sufficient to overcome the depreciated purchasing power of the wage earner's dollar.

According to the National Industrial Conference Board the purchasing value of the dollar, based on July, 1914 as $1, fluctuated as follows: June, 59.9c.; July, 59.3c.; September, 59.4c.; November, 1925, 58.4c.



In following the relation of cost to construction volume, as shown by the accompanying chart, the depression in the latter which occurred during the last half of 1920, was contrary to the rule that lower costs make for increased volume. The recession in costs during 1921 and 1922, however, resulted in a commensurate increase in volume. The 1923 rise in cost did not serve to inhibit the growth of the boom.

P.R.R. Orders Hundred 13,000 Gal. Locomotive Tenders

Orders for 100 locomotive tenders, each with a water capacity of 13,000 gallons, have been placed with the Baldwin Locomotive Works by the Pennsylvania Railroad. The new tenders will be used with heavy freight locomotives to reduce, through their enlarged capacity, the number of stops for water to a minimum.

Deliveries have commenced on orders placed last summer with a number of car building companies for 357 all-steel passenger equipment cars. These include 105 coaches; 15 combination passenger and baggage cars; 15 combination passenger, baggage and mail cars; and 222 baggage-express cars.

January Bond Sales For State and Municipal Improvement Lightest Since 1919

BOND sales for January were lighter than for the month preceding and also for the month of January each year since 1919, according to the *Commercial and Financial Chronicle*. The total for the month was $68,264,291, compared with $135,311,122 for January a year ago and $157,563,426 for December.

The number of municipalities in the United States issuing permanent bonds and the number of separate issues made in January, 1926 were 254 and 320 respectively. This contrasts with 377 and 501 of January, 1925.

Some of the larger issues placed during January follow: $6,000,000 5s, school bonds, and $1,000,000 5s, Hetch Hetchy water bonds, San Francisco, Calif.; $5,650,000 4½s. of Rochester, N. Y.; $1,100,000 5s of St. Petersburg, Fla.; $4,000,000 5s, school bonds, of Los Angeles, Calif.; $2,983,746 4½, street, water-works and other improvements, Minneapolis, Minn.; $2,200,000 4½s of Ft. Worth, Tex.; and $2,000,000 4½s, water bonds, of Knoxville, Tenn.

In the accompanying table the rates range from 4¼ to 5 per cent. A few placements were made at par but the greater number drew a premium. None, however, sold below par.

Representative Public Bond Sales, January, 1926

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased by
Alabama	Harbor Impvt.	$1,100,000	4¼	100.24	4.24	Jan. 1	1933-76	First Nat. Bk. N. Y. C. and others
County								
Adams, Miss	Court House	60,000	5	101.15	....	.....	.....	William R. Compton Co.
Adams, Ind	Road	20,800	4½	101.11	4.29	Jan. 15	1927-36	First Nat. Bk. of Decatur
Benton, Ind	Road	32,200	4½	100.90	4.32	Jan. 15	1927-34	City Securities Corp. of Indianapolis
Bexar, Tex	Court House, Bridge, Juvenile Home	1,400,000 / 600,000 / 50,000	4¼	.....	....	April 10	1927-65	J. E. Jarrett & Co. of San Antonio
Baker, Ore	Road	150,000	5	103.68	4.7	Dec. 15	1944	First Nat. Bk. of Baker
Baltimore, Md	School	500,000	4½	103.01	4.30	Feb. 1	1947-54	Harris Forbes & Co., Mercantile Safe Deposit & Trust Co.
	Road and School	750,000		102.93	4.31			
Belmont, O	Road	44,972	5	101.56	4.65	Nov. 1	1926-34	A. T. Bell & Co. of Toledo
Blount, Tenn	Highway	35,000	5	100.40	4.88	Sept. 1	1926-32	N. S. Hill & Co. of Cincinnati
Chenango, N. Y	Highway Impvt.	100,000	4½	101.75	4.14	Feb. 1	1951-55	Chenango Nat. Bk. of Norwich
Cass, Minn	Road	50,000	5½	100	5½	Jan. 2	1930	Wells-Dicky Co. of Minneapolis
Carroll, Ind	Road	23,100	4½	100.88	....	.....	.....	Merchants Nat. Bk. of Muncie and others
Columbiana, O	Road Impvt.	28,000	5	101.36	4.72	.....	1927-36	Provident Savings Bk. & Trust Co. of Cincin.
De Kalb, Ind	Road	21,300	4½	102.82	....	June 15	.....	J. F. Wild & Co. of Indianapolis
Davidson, N. C	Road and Bridge	300,000	5	100.35	....	Jan. 4	.....	W. K. Terry & Co. of Toledo
Erie, O	Bridge	20,000	5½	100	....	April 1	1926-35	Sinking fund
Fayette, Pa	Bridge	350,000	4½	100.51	4.21	Dec. 30	1930-45	W. H. Newbold's Son & Co. of Philadelphia
Floyd, Ind	Road	18,000	5	103.08	4.41	.....	1927-36	Cities Securities Corp. of Indianapolis
Greenville, S. C	Paving	200,000	4½	101.84	4.62	Jan. 1	1946	H. M. Byllesby & Co. of Chicago
Hinds, Miss	Road	600,000	4½	100.116	4.74	Jan. 1	1927-51	The Detroit Co. of N. Y. and others
Hennepin, Minn	Ditch	8,700	4½	100	....	Jan. 1	1927-33	Sinking fund
Henry, Ga	Road	45,000	5	101.51	4.59	Jan. 1	1927-33	J. H. Hilsman & Co., Inc., of Atlanta
Habersham, Ga	Road	225,000	5	.....	....	Jan. 20	1931-55	J. H. Hilsman & Co., Inc.
Hamilton, Ind	Road Impvt.	10,500	4½	100.57	4.38	Dec. 1	1926-35	First Nat. Bk. of Noblesville
Levy, Fla	Road Impvt.	100,000	5½	.....	....	Jan. 20	1955	R. M. Grant & Co. Inc., of N. Y.
Township								
Cheltenham, Pa	Sewer	200,000	4½	101.01	4.38	Nov. 1	1935	W. H. Newbold's Son & Co. of Philadelphia
Lakewood, N. J	Road Impvt.	113,000	4½	.....	....	Dec. 18	15 years	M. M. Freeman & Co. of Philadelphia
Togalhama, Pa	.....	40,000	4½	100.29	....	.....	15 years	A. B. Leach & Co. of Philadelphia
Municipal								
Axtell, Kan	Water Works	45,000	4½	.....	....	Sept. 1	1926-45	Brown-Crummer Co. of Wichita
Beaver Dam, Wis	Water Works	10,000	4½	100.057	....	Jan. 15	1930-39	Hill-Joiner Co. of Chicago
Boise City, Ida	Station Approaches	115,000	4½	100.06	4.49	Feb. 1	1945	John B. Cruzen of Boise City
Bridgeport, Conn	School, Bridge, Improvement	500,000 / 400,000 / 180,000	4¼	100.2197	4.24	Feb. 2	1927-56	H. L. Allen & Co. of N. Y. and others
Beaumont, Tex	Streets	400,000	5	101.17	4.93	Feb. 1	1927-66	Stifel-Nicolaus & Co., Inc., of St. Louis
	Sewers	200,000	5	101.17	4.92			
	Public Safety	100,000	5	101.17	4.92			
	Park	50,000	5	101.17	4.93			
Burlington, Ia	Improvement, City Hall	12,500 / 14,000	..	100.18	....	Jan. 1	1927-32	Geo. M. Bechtel & Co. of Davenport
Burlington, Kan	Improvement	60,000	4½	100	4½	July 1	1926-45	Peoples Nat. Bk. of Burlington
Chula Vista, Calif	Sewer, Park	40,000 / 50,000	..	100.22	....	.....	.....	R. E. Campbell & Co. of Los Angeles
Decatur, Ill	Water Works Impvt., Electric Light Plant, Fire House, City Hall	150,000 / 70,000 / 55,000 / 40,000	..	101.94	....	.....	.....	Milliken Nat. Bk. of Decatur

Weekly Construction Market

BRICK and lumber continue firm with marked upward trend owing to recent severe weather conditions. For three successive weeks, prices on the principal hot-rolled steel products have been as follows: reinforcing bars, $2; structural shapes, $1.90@$2; plates, $1.80@$1.90 per 100 lb. at Pittsburgh mills. A total of 3,655,317 bbl. of cement were imported into the United States during the year 1925, according to the Bureau of Mines. This represents a gain of 81 per cent over the year preceding. Compared with this only 1,019,597 bbl. were exported during the year; a gain of 16 per cent over 1924. While both imports and exports gained in 1925, there was an excess of the former over the latter of more than 261 per cent. With active foreign competition developing and no tariff on cement from those countries not levying duties against products of the United States, domestic manufacturers persevere in an extensive program of new cement mill construction. Since Jan. 1, 1926, new mills have been definitely proposed as follows: Dayton Portland Cement Co., at Germantown, Ohio, $1,000,000; Buffalo Slag Co., at Buffalo, N. Y., $2,000,000; Dewey Portland Cement Co., at Davenport, Ia., $3,000,000. Plans are being prepared or have been completed on the Ocala Portland Cement Co.'s plant at Ocala, Fla., $2,500,000 and a mill for the Great Lakes Portland Cement Co., at Buffalo, N. Y., $3,000,000. The Universal Portland Cement Co. has purchased a site at Cleveland, Ohio, for a mill to cost $2,000,000. The Phœnix Portland Cement Corp. will erect a mill at Powderly, Ala., by day labor, to cost $2,500,000. The seven projects total $16,000,000. Evidently the cement manufacturers expect the heavy building demand to continue or perhaps preparation is already under way to meet a future timber shortage.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb	4.50	3.50	4.75	3.50	3.75	4.65	5.00	3.75	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.30	3.38	3.00	3.25	3.77½	3.10	3.25	2.30
Steel pipe, black, 2½ to 6 in. lap, discount	48%	53%	53.6%	51%	54 25%	36%	39.2@51%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@52.60	45.30	54.00	50.20@51.20	53 00	64.00	51.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.70	2.30	2.05	2.10	2.32	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1 75	1.90	2.38	2.00@2.20	1.65	1.90	1.80	1.50	1.25
Sand, cu.yd	1 00	1.50	2.00	2 25	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.50	2.83	2.00@2.20	1.75	2.50	—1.70	3.00	1.50
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+63 00	34.00	56 00	57.50	37.75	49.50	27.00	25.00	65.00
Lime, finishing, hydrated, ton	18 20	22.50	20 00	20 00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2 25	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	21.00	10.50	11.10	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0977	.10	.075	.....	.075	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1112	.0977	.10	.075	.07	075	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal	.87¾	.96	1.13	.88	.99¾	1.14	1.02	1.12	1.12
Common Labor									
Common labor, union, hour	.62½@.75	.30	....	87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	82½	.45@.55	.35@.50	.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual bidings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 4, the next on March 4.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.62). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 4¾@5 per cent, Feb. 19; year ago, 3 per cent.

Time loans: sixty-ninety days, 4⅝@4¾; four-six months, 4⅝@4¾ per cent.

Commercial paper: best names, 4¼ per cent; other names, 4¾ per cent.

On February 1, 1926

E. N.-R. Construction Cost Index Number 206.55

E. N.-R. Construction Volume Index Number 198

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month